Devoted to
TEXTILE
CHEMISTRY
BLEACHING
DYEING
PRINTING
FINISHING

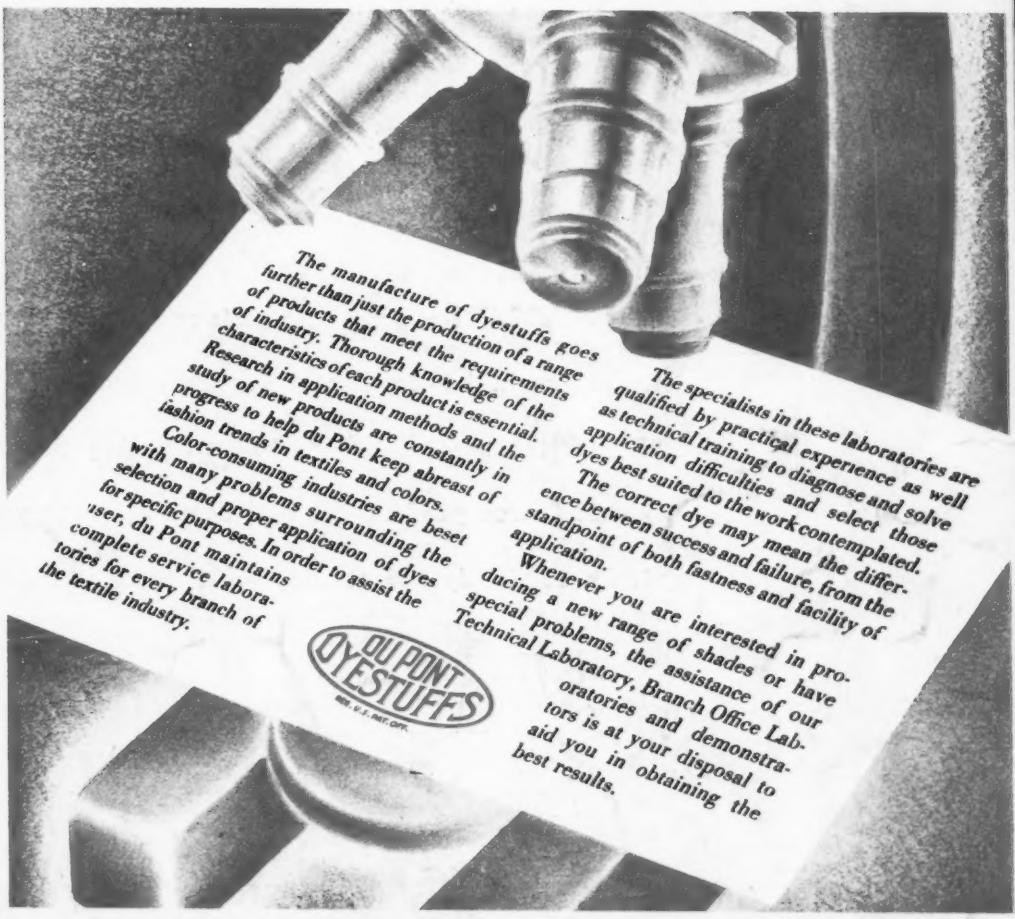
EPTEMBER 15, 1941
OLUME 30, No. 19

AMERICAN LIBRARY
RECEIVED
SEP 30 1941
U. S. Department of Agriculture

DYESTUFF REPORTER

OFFICIAL PUBLICATION
of the
PROCEEDINGS
MERICAN ASSOCIATION
OF TEXTILE CHEMISTS
AND COLORISTS

DU PONT TECHNICAL SERVICE



The manufacture of dyestuffs goes further than just the production of a range of products that meet the requirements of industry. Thorough knowledge of the characteristics of each product is essential. Research in application methods and the study of new products are constantly in progress to help du Pont keep abreast of fashion trends in textiles and colors.

Color-consuming industries are beset with many problems surrounding the selection and proper application of dyes for specific purposes. In order to assist the user, du Pont maintains complete service laboratories for every branch of the textile industry.

The specialists in these laboratories are qualified by practical experience as well as technical training to diagnose and solve application difficulties and select those dyes best suited to the work contemplated.

The correct dye may mean the difference between success and failure, from the standpoint of both fastness and facility of application.

Whenever you are interested in producing a new range of shades or have special problems, the assistance of our Technical Laboratory, Branch Office Laboratories and demonstrators is at your disposal to aid you in obtaining the best results.

DU PONT DYESTUFFS
REG. U.S. PAT. OFF.

E. I. DU PONT DE NEMOURS AND COMPANY, INCORPORATED

Organic Chemicals Department, Dyestuffs Division, Wilmington, Delaware

BRANCH OFFICES: Boston, Mass. Charlotte, N. C. Chicago, Ill. Philadelphia, Pa. Providence, R. I. New York, N. Y. San Francisco, Calif.

Wetting Through is Quick and Thorough

With WARCOSOL, wetting through is even more instantaneous than in the case of our dampened-down heroine. It lowers the surface tension to an amazing degree. Like all Warco products, it will do the job for you quickly, efficiently and at measurable savings in cost.

WARWICK

Chemical Company

WEST WARWICK, R. I. • ROCK HILL, S. C. • 580 FIFTH AVENUE, N. Y. C.

Copyrighted 1941, Warwick Chemical Co., West Warwick, R. I.

American Dyestuff Reporter, Vol. 30, No. 19, September 15, 1941. Published every other Monday. Copyright, 1941, by Howes Publishing Co., 440 4th Ave., New York, N. Y. Domestic sub-cription, $5.00; Canadian, $6.00; Foreign, $6.00. Entered as second-class matter, Nov. 6, 1919 at the New York, N. Y. Post Office, under the act of March 3, 1879.

AMERICAN DYESTUFF REPORTER

A. P. HOWES
Publisher

LOUIS A. OLNEY
Directing Editor

NORMAN A. JOHNSON
Managing Editor

MYRON D. REESER
Advertising Manager

Official Publication of the Proceedings of the American Association of Textile Chemists and Colorists

SEPTEMBER 15, 1941

VOLUME 30 NUMBER 19

American Dyestuff Reporter, Vol. 30, No. 19, Sept. 15, 1941. Published every other Monday. Copyright, 1941, by Howes Publishing Co., 440 4th Ave., New York, N. Y. Domestic subscription, $5.00, Canadian, $6.00, Foreign, $6.00. Entered as second-class matter, Nov. 6, 1919, at the New York, N. Y., Post Office, under the act of March 3, 1879.

Contents

Contents of previous issues can be found by consulting the Industrial Arts Index at your library

• Special Articles

A Serviceability Study of Full-Fashioned Cotton Hose for Nurses 471
Margaret B. Hays, Emma C. Petersen and Viola C. Jelinek

Comparison of Some Physical Properties Affecting the Serviceability of Certain Wool, Rayon, and Wool and Rayon Mixed Fabrics..... 491
Hazel Fletcher, Mary Caroline Boyer and Sister Mary Catherine Floersch

Textile Industries Share in Civilian Defense Plans..... 497
Leonard F. Maar

• Proceedings of the American Association of Textile Chemists and Colorists

The Significance and Utility of Cuprammonium Fluidity in Textile Bleaching..... P481
F. L. Fennell

Outing, Mid-West Section..... P486

Intersectional Contest P487

Transportation, Annual Meeting..... P488

Calendar of Coming Events..... P490

• Departments

Trade Notes—New Products..... 496

Copyright, 1941, Howes Publishing Co., Inc.

Crisp, cool duck suits wrinkled themselves out of favor. But crush resistant spun-rayon threatens to revive the popularity of colorful, linenlike suiting . . . adding still one more fabric to the bewildering array of acetate and rayon-mixtures already in use.

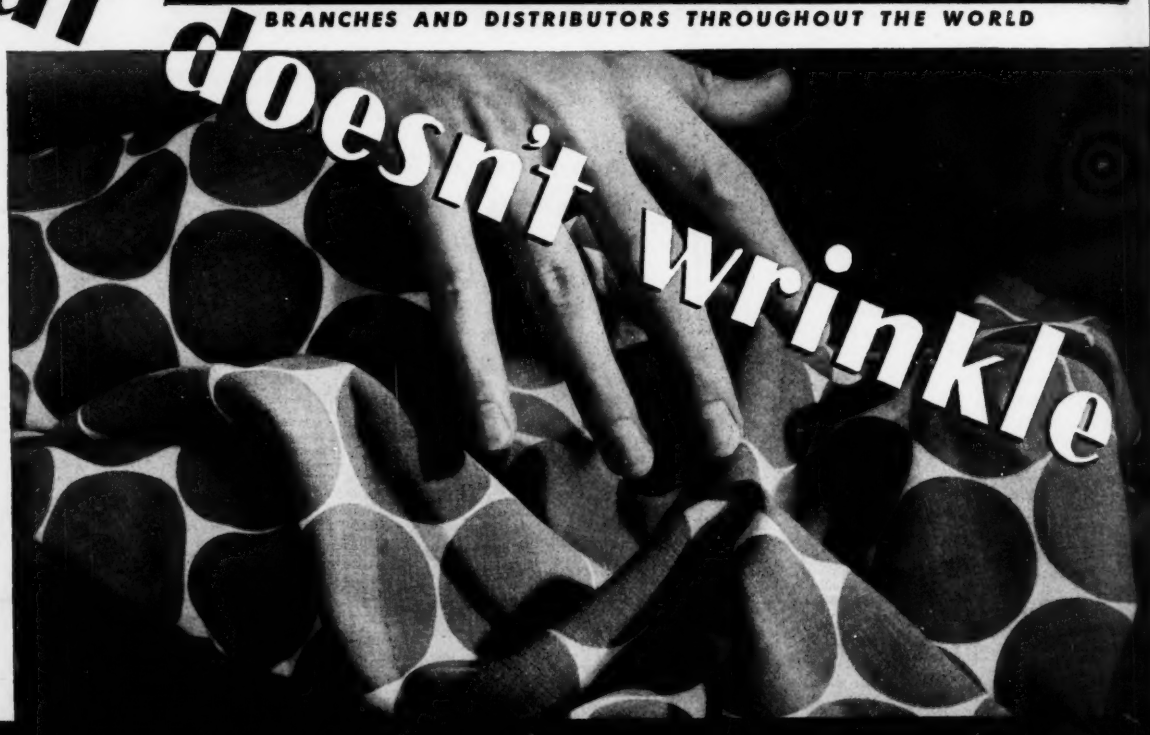
Whatever your color problems may be with these new synthetic mixtures, National Technical Service will gladly help you get the most economical formulas to meet your own conditions.

NATIONAL ANILINE & CHEMICAL COMPANY, INC.

40 RECTOR STREET NEW YORK, N. Y.

BOSTON	150 Causeway St.	SAN FRANCISCO	517 Howard St.	NEW ORLEANS	Masonic Temple Bldg.
PROVIDENCE	15 Westminster St.	CHARLOTTE	201-203 W. First St.	CHATTANOOGA	James Bldg.
CHICAGO	357 W. Erie St.	GREENSBORO	Jefferson Standard Bldg.	PORTLAND, ORE.	730 West Burnside
PHILADELPHIA	200-204 S. Front St.	ATLANTA	140 Peachtree St.	TORONTO	137-145 Wellington St., W.

BRANCHES AND DISTRIBUTORS THROUGHOUT THE WORLD



AMERICAN
DYESTUFF REPORTER

VOLUME 30 SEPTEMBER 15, 1941 NUMBER 19

A Serviceability Study of FULL-FASHIONED COTTON HOSE for Nurses*

MARGARET B. HAYS, EMMA C. PETERSEN and VIOLA C. JELINEK
Textile Physicist *Assistant Scientific Aid* *Junior Chemist*

Division of Textiles and Clothing, U. S. Bureau of Home Economics

TO determine under reproducible conditions the amount of service obtained from women's cotton hosiery, the United States Bureau of Home Economics as part of its cotton utilization program recently manufactured four constructions of cotton full-fashioned hose and subjected them to a service test. This is believed to be the first time that cotton hosiery or women's full-fashioned hosiery of known constructions have been tested under controlled service conditions and the first time that chemical laboratory tests as well as physical analyses have paralleled the service test.

At present there is great interest in the relation of hosiery laboratory tests to consumer wear[1, 6]. Although laboratory techniques and performance tests have been established[10], very little information is available on the length of service of hose in actual use. Of the few service studies that are reported in the literature, most have been made on silk hosiery with a very limited number of cotton hose sometimes included for purposes of comparison[2, 4, 9].

For this service test, nurses' white hose were selected. Student nurses are desirable cooperators for this type of study because they are consumers in one occupational group in one geographic location.

In order to study the relation between service and laboratory tests, hose were tested at regular intervals of wear. Deterioration was measured by wale and course count, bursting strength, elongation, fluidity in cuprammonium hydroxide, elastic properties, shrinkage, weight, weight distribution, areas of wear, and length of service.

*Appreciation is expressed to Maud Doherty, Director of Nurses, Garfield Memorial Hospital, Washington, D. C., and Margaret Duffey, former Science Instructor, of the same institution, for their cooperation which made this study possible. A. E. Brandt, Chief, Conservation Experiment Stations Division, U. S. Soil Conservation Service, suggested the method of sampling. O. A. Pope, Associate Agronomist, U. S. Bureau of Plant Industry, gave valuable advice on the method of analyzing the data. Acknowledgment is also made to Hyman D. Rothkopf, former Junior Scientific Aide, U. S. Bureau of Home Economics, for conducting the yarn tests. The knitting specifications were prepared by David H. Young, Senior Marketing Specialist, of the same organization.

MATERIALS

Commercial cotton yarns, combed, gassed, and mercerized were purchased in two weights, 90/2 and 120/2. These yarns were mule spun from long-staple American-grown cotton. The staple length at the 25 percentile determined from the yarns as delivered was 1.344 inches for the 90/2's and 1.333 inches for the 120/2's. The breaking strengths by the single strand method were 0.72 pound and 0.44 pound; the elongation was 3.8 and 3.9 per cent; the singles had 31 Z and 41 Z turns per inch; the ply 28 S and 34 S turns per inch for the 90/2's and 120/2's respectively.

The hose were knit size 9½ on a 42 gauge full-fashioned hosiery machine with 24 sections. The manufacturing specifications are given in Table 1 and the type of foot reinforcement is shown in Figure 1. All four constructions were knit 32 inches long on the same machine and each hose was marked with the number of the section (1 to 24) of the full-fashioned hosiery machine on which it was knit. The section number for each test hose is indicated in Tables 2 and 3 even though it was not feasible to sample systematically by machine section. These num-

Figure 1—Type of foot reinforcement for hose used in the service test.

bers were intended as guides if it were necessary to reject any very low test value because of friction on the yarn from worn travelers on the knitting machine. Sometimes a pair consisted of two hose knit on the same machine section. Since pairing is on a length basis, this may occur frequently as the same section could be expected to knit two that were of the same length and quality more frequently than two different sections of the machine. The knit hose were scoured and bleached but not dyed. They were boarded and paired by length in accordance with the regular practice of the knitting mill.

METHODS

All hose were given identifying numbers, weighed, measured in four places, and laundered before distribution. Four pairs of hose, one of each of the four constructions, were worn in rotation by 68 student nurses who volunteered to cooperate. Only girls who normally wore size 9½ hose were included. The student nurses, on duty

TABLE 1
Specifications for the Knitting of Four Constructions of 42 Gauge Full-Fashioned Cotton Hose

Construction	Courses per Inch	4 Inch Double Welt and 1 Inch Flare: Type	4 Inch Double Welt and 1 Inch Flare: Yarn Number	Picot Runstop	Main Yarn Number	Heel Tab, Sole, and Toe Reinforcement Yarn Number	Seam: Stitches per Inch	Seam: Yarn Number
A	42 to 44	Plain conventional	90/2	1	90/2	90/2	20	90/3
B	42 to 44	4 regular length, 2 loose.....	90/2	1	90/2	90/2	20	90/3
C	46 to 48	Plain conventional	90/2	2	120/2	90/2	20	90/3
D	46 to 48	4 regular length, 2 loose.....	90/2	2	120/2	90/2	20	90/3

TABLE 2
Wale and Course Count, Bursting Strength, Elongation, and Fluidity of 4 Constructions of Cotton Hosiery After Repeated Laundering and Wear

Period of Service, Days	Group* No.	Knit on Machine Section, No.	Wales† per Inch, No.	Courses† per Inch, No.	Bursting† Strength, Lbs.	Elongation†, Inches	Fluidity: Leg Reciprocal Poises	Fluidity: Foot Reciprocal Poises
A (90/2 plain welt)								
	1	6	31	48	52.7	0.24	4.12	4.04
0	2	16	34	50	60.1	.24	4.24	4.12
	3	13	33	48	54.5	.26	4.23	4.20
	4	16	34	48	57.0	.27	4.26	4.15
	1	20	32	50	50.8	.21	...	...
4	2	9	32	50	45.4	.21	...	...
	3	13	32	47	44.0	.21	...	...
	4	24	32	47	47.1	.23	...	...
	1	22	31	50	46.5	.24	5.53	5.38
8	2	17	32	48	46.4	.24	5.14	5.34
	3	22	32	49	46.7	.23	4.89	5.18
	4	23	31	48	45.6	.23	5.03	4.92
	1	24	31	47	42.2	.26	...	...
12	2	11	30	48	43.8	.23	...	...
	3	11	32	48	47.1	.25	...	...
	4	23	31	49	45.4	.24	...	...
	1	22	31	51	39.2	.22	5.13	5.19
16	2	19	32	49	44.5	.25	5.43	5.42
	3	17	30	47	40.8	.21	5.11	5.09
	4	18	31	49	42.0	.23	6.12	5.80
	1	7	30	48	39.2	.24	...	...
20	2	21	32	46	42.6	.23	...	...
	3	9	31	47	46.8	.25	...	...
	4	19	32	47	44.7	.25	...	...
	1	23	31	48	40.5	.24	6.42	6.27
24	2	16	30	52	39.7	.18	6.06	5.38
	3	13	32	47	43.4	.20	5.82	5.41
	4	17	32	47	42.4	.18	5.91	5.74
	1	21	30	48	42.7	.21	6.90	6.02
28	2**	..	31	47	42.3	.21	6.45	6.67
	3	8	32	48	44.0	.25	6.93	6.29
	4	19	32	49	41.9	.21	6.25	6.24
	1	11	30	49	39.3	.22	6.90	6.34
32	2	16	31	52	41.3	.22	7.65	6.80
	3	23	30	49	41.2	.23	6.56	6.33
	4	2	31	49	37.7	.20	6.25	6.08
B (90/2 stretch welt)								
	1	16	33	50	55.5	0.24	4.17	4.39
0	2	8	33	47	55.2	.25	4.42	4.19
	3	15	32	47	53.7	.21	4.29	4.26
	4	3	33	47	51.6	.24	4.42	4.23
	1	17	32	47	46.7	.21	...	...
4	2	8	31	48	45.3	.21	...	...
	3	15	32	47	45.9	.20	...	...
	4	11	32	48	48.6	.21	...	...
	1	17	32	48	44.6	.21	4.68	4.99
8	2	8	32	46	43.2	.19	4.54	4.57
	3	13	33	46	43.9	.20	4.70	5.10
	4	20	32	47	46.1	.19	4.83	4.58
	1	15	31	49	44.1	.26	...	...
12	2	24	30	48	43.4	.26	...	...
	3	23	31	47	47.6	.25	...	...
	4	13	32	46	44.9	.26	...	...
	1	8	31	47	38.5	.23	5.08	5.30
16	2	3	32	49	40.3	.23	5.14	5.43
	3	7	31	49	42.7	.23	5.35	5.57
	4	9	31	49	43.1	.21	5.40	5.30
	1	11	31	49	46.9	.25	...	...
20	2	18	31	45	41.4	.20	...	...
	3	15	32	48	42.0	.25	...	...
	4	24	32	47	43.0	.25	...	...
	1	20	31	48	37.4	.22	6.55	6.60
24	2	8	32	47	40.2	.21	5.75	5.43
	3	9	32	48	42.9	22.	5.79	5.61
	4	12	29	49	41.9	.19	6.07	5.99
	1	16	31	51	45.0	.24	7.12	6.07
28	2	17	31	45	37.9	.21	6.21	7.76
	3	24	32	46	41.3	.24	6.38	6.15
	4	11	32	48	39.9	.23	5.89	5.98
	1	3	30	48	40.4	.22	7.33	6.51
32	2	24	30	46	36.4	.23	6.62	6.07
	3	11	31	47	41.9	.22	6.98	6.44
	4	16	30	51	42.4	.23	6.57	5.97

C (120/2 plain welt)								
	1	1	33	52	40.4	.19	4.26	4.19
0	2	3	32	52	38.7	.23	4.45	4.50
	3	2	33	51	41.1	.20	4.29	4.54
	4	4	34	52	38.1	.23	4.54	4.34
	1	6	32	54	36.9	.21	...	...
4	2	8	33	51	35.8	.21	...	...
	3	23	33	52	36.7	.22	...	...
	4	20	32	54	36.9	.21	...	...
	1	9	32	53	31.0	.18	5.70	5.13
8	2	17	32	51	30.3	.18	4.79	4.76
	3	21	33	53	33.2	.16	4.89	4.84
	4	1	32	52	34.5	.17	4.81	4.77
	1	5	32	54	36.8	.26	...	...
12	2	21	32	53	35.3	.25	...	...
	3	10	31	52	34.5	.21	...	...
	4	20	31	52	33.2	.21	...	...
	1	21	32	51	32.7	.20	5.05	5.18
16	2	15	32	52	29.0	.18	5.58	4.95
	3	17	32	50	28.9	.19	5.19	5.17
	4	8	32	51	31.8	.19	5.86	5.25
	1	19	32	52	34.3	.23	...	...
20	2	8	32	49	33.3	.21	...	...
	3	6	31	51	29.7	.23	...	...
	4	13	33	50	34.2	.25	...	...
	1	24	30	53	29.6	.22	6.20	5.83
24	2	6	32	53	27.7	.22	6.50	5.60
	3	17	33	50	29.2	.23	6.04	6.05
	4	18	31	49	26.9	.20	6.71	5.52
	1	21	31	53	28.1	.20	6.83	6.25
28	2	17	32	50	30.4	.21	6.40	6.31
	3	20	32	50	31.0	.23	6.51	6.19
	4	12	30	53	29.2	.22	6.92	6.21

D (120/2 stretch welt)								
	1	5	33	51	40.4	.24	4.65	4.29
0	2	20	34	52	39.2	.21	4.62	4.51
	3	16	33	52	40.1	.21	4.60	4.32
	4	17	33	50	41.0	.20	4.92	4.24
	1	13	33	51	34.6	.24	...	...
4	2	21	32	54	38.6	.22	...	...
	3	22	32	53	38.6	.18	...	...
	4	20	33	53	37.2	.22	...	...
	1	8	32	52	36.5	.18	5.05	5.40
8	2	22	31	54	35.1	.18	4.72	4.87
	3	17	32	53	32.0	.17	4.95	5.00
	4	13	33	50	35.6	.20	4.71	4.75
	1	24	32	51	34.0	.23	...	...
12	2	2	32	51	30.0	.21	...	...
	3	10	34	53	32.9	.24	...	...
	4	22	32	51	34.0	.22	...	...
	1	16	32	54	28.8	.20	5.59	5.12
16	2	9	31	54	29.4	.17	5.51	5.17
	3	20	33	52	30.1	.20	5.22	5.08
	4	7	32	51	32.8	.21	5.76	5.11
	1	23	32	51	32.0	.23	...	...
20	2	15	32	52	29.7	.24	...	...
	3	2	33	50	33.8	.24	...	...
	4	3	33	49	30.3	.24	...	...
	1	2	31	50	29.0	.20	6.85	6.56
24	2	11	32	52	32.2	.21	6.33	5.63
	3	6	31	53	26.4	.21	6.39	6.12
	4	21	32	52	28.6	.21	6.59	6.39
	1	8	30	51	29.7	.22	7.96	6.26
28	2	15	31	52	31.8	.21	6.82	5.92
	3	5	32	52	34.0	.23	6.33	6.20
	4	6	30	53	29.6	.23	6.53	6.43

*Group No. 1 = tall heavy, 2 = short heavy, 3 = tall light, 4 = short light.
†Average of five determinations.
**For statistical analyses, values were calculated for this hose which the wearer lost.

TABLE 3
Elastic Properties (Frazier Test) of Cotton Hose Tested After Various Amounts of Service

			Plain Welt								*Stretch Welt*							
Period of Service	*Group* No.*	*Knit on Machine Section No.*	*Stretch Endurability*	*Recovery Load at 19.2 Inches (r)*	*Stretch Load at 19.2 Inches (s)*	*Stretch Load at 20.2 Inches (s')*	*Stretch Load Increase from 19.2 to 20.2 Ins. (s'-s)*	*Recovery Stretch Ratio (r/s)*	*Circumference Below Welt Before Washing*		*Knit on Machine Section No.*	*Stretch Endurability*	*Recovery Load at 19.2 Inches (r)*	*Stretch Load at 19.2 Inches (s)*	*Stretch Load at 20.2 Inches (s')*	*Stretch Load Increase from 19.2 to 20.2 Ins. (s'-s)*	*Recovery Stretch Ratio (r/s)*	*Circumference Below Welt Before Washing*
Days			*Cycles*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*%*	*Ins.*			*Cycles*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*%*	*Ins.*
	A (90/2)										B (90/2)							
	1	3	2000	5.0	10.0	17.8	7.8	50.0	...		1	2000	5.0	12.2	21.8	9.6	41.0	...
0	2	16	2000	6.1	15.6	30.0	14.4	39.1	...		18	2000	3.9	7.8	12.8	5.0	50.0	...
	3	12	2000	5.6	11.7	20.6	8.9	47.9	...		15	2000	4.4	11.7	20.0	8.3	37.6	...
	4	16	1900	5.6	13.3	28.8	15.5	42.1	...		10	2000	4.4	11.1	18.3	7.2	39.6	...
	1	2	1650	4.4	14.5	28.8	14.3	30.3	12.0		13	2000	5.0	10.6	17.2	6.6	47.2	11.8
4	2	9	2000	2.2	6.1	26.4	20.3	36.1	15.5		8	2000	2.2	11.1	25.2	14.1	19.8	15.8
	3	8	2000	3.3	11.1	27.6	16.5	29.7	11.8		11	2000	2.2	7.8	25.8	18.0	28.2	12.8
	4	19	2000	2.2	7.2	24.1	13.9	30.6	13.6		12	2000	3.3	8.9	21.2	12.3	37.1	13.6
	1	22	2000	2.8	8.9	31.8	22.9	31.5	12.2		4	2000	2.8	10.0	25.8	15.8	28.0	12.6
8	2	8	2000	4.4	8.9	18.4	9.5	49.4	14.2		6	2000	2.2	9.4	23.5	14.1	23.4	16.2
	3	3	2000	3.9	13.3	27.0	13.7	29.3	12.5		13	2000	3.3	10.0	21.2	11.2	33.0	12.9
	4	11	2000	3.3	11.1	28.8	17.7	29.7	14.5		8	2000	3.3	10.6	20.6	10.0	31.1	14.5
	1	15	2000	3.3	11.7	26.4	14.7	28.2	12.5		23	2000	2.2	10.0	24.7	14.7	22.0	13.1
12	2	1	2000	1.7	3.9	23.5	19.6	43.6	16.4		24	2000	1.7	6.7	17.8	11.1	25.4	18.6
	3	7	2000	2.2	11.1	29.4	18.3	19.8	12.9		23	2000	3.3	11.7	23.5	11.8	28.2	14.5
	4	10	2000	4.4	15.0	28.8	13.8	29.3	14.5		11	2000	3.3	11.1	22.9	11.8	29.7	14.1

	1	4	0	3.9	13.9	25.8	11.9	28.1	16.2	24	2000	2.8	7.8	15.0	7.7	35.9	16.8
16	2	4	2000	2.2	8.9	26.4	17.6	24.7	16.9	3	2000	2.2	9.4	21.2	11.8	23.4	17.6
	3	6	2000	4.4	11.7	22.3	10.6	37.6	15.8	2	2000	2.8	10.6	21.8	11.2	26.4	15.0
	4	22	2000	3.3	12.8	31.8	19.0	25.8	13.4	6	2000	3.9	8.9	15.6	6.7	43.8	16.1
	1	1	2000	5.0	14.5	28.8	14.3	34.5	13.2	11	2000	3.3	10.0	17.8	7.8	33.0	13.6
20	2	6	2000	3.9	12.2	24.7	12.5	32.0	14.8	18	2000	3.3	8.9	16.1	7.2	37.1	16.2
	3	12	2000	3.9	11.7	25.8	14.1	33.3	11.9	20	2000	3.9	10.6	21.8	11.2	36.8	12.4
	4	4	2000	3.3	9.4	26.4	17.0	35.1	12.2	24	2000	3.3	10.0	17.8	7.8	33.0	12.8
	1	11	2000	4.4	12.2	22.9	10.7	36.1	12.5	18	2000	3.3	8.3	15.0	6.7	39.8	13.6
24	2	9	2000	3.9	13.3	28.8	15.5	29.3	12.1	24	2000	2.8	7.8	16.1	8.3	35.9	14.0
	3	19	2000	3.3	10.0	18.4	8.4	33.0	12.8	9	2000	3.3	10.6	24.1	13.5	31.1	12.6
	4	15	2000	3.9	12.2	24.7	12.5	32.0	13.6	1	2000	3.3	12.2	20.6	8.4	27.0	16.9
	1	23	2000	4.4	13.3	24.7	11.4	33.1	12.5	21	2000	3.9	10.6	17.8	7.2	36.8	13.9
28	2†	..	....	3.5	11.7	24.2	12.5	29.9	12.9	14	2000	2.8	9.4	18.9	9.5	29.8	13.1
	3	8	2000	3.9	11.1	18.9	7.8	35.1	11.6	24	2000	3.3	8.9	16.1	7.2	37.1	12.2
	4	22	360	3.3	10.0	24.7	14.7	33.0	17.5	2	0	2.8	10.0	16.7	6.7	28.0	17.5
	1	7	2000	3.9	11.1	22.9	11.8	35.1	13.5	3	2000	3.9	10.6	18.4	7.8	36.8	12.6
32	2	16	0	5.0	15.6	27.6	12.0	32.1	16.8	24	2000	3.3	8.3	15.6	7.3	39.8	17.5
	3	7	2000	4.4	11.7	22.3	10.6	37.6	12.5	6	2000	3.9	10.0	16.1	6.1	39.0	12.6
	4	19	2000	5.0	13.3	24.7	11.4	37.6	15.5	16	2000	3.9	13.3	25.2	11.9	29.3	15.5
	C (120/2)									D(120/2)							
	1	3	840	4.4	8.9	27.6	18.7	49.4	...	24	899	3.9	10.0	21.8	11.8	39.0	...
0	2	1	565	4.4	8.3	30.0	21.7	53.0	...	23	788	3.3	11.1	25.8	14.7	29.7	...
	3	1	710	5.0	11.1	30.0	18.9	45.0	...	17	1190	3.9	13.3	27.0	13.7	29.3	...
	4	5	810	3.3	9.4	28.2	18.8	35.1	...	24	1396	3.3	10.0	22.3	12.3	33.0	...
	1	11	2000	5.0	17.8	31.8	14.0	28.1	11.9	11	2000	3.3	12.8	25.8	13.0	25.8	12.0
4	2	7	1694	2.8	5.6	26.4	20.8	50.0	15.8	19	356	2.2	6.7	32.4	25.7	32.8	15.5
	3	12	6	2.8	6.7	33.6	26.9	41.8	12.4	20	100	3.3	12.2	28.8	16.6	27.0	12.5
	4	6	390	4.4	15.0	42.4	27.4	29.3	13.5	23	765	2.8	13.9	33.6	19.7	20.1	14.1
	1	10	1530	3.9	13.3	36.1	22.8	29.3	13.2	21	2000	3.3	12.2	22.9	10.7	27.0	14.1
8	2	1	0	2.2	6.7	29.4	22.7	32.8	14.5	15	2000	3.3	14.5	24.7	10.2	22.8	15.8
	3	19	0	2.2	7.2	30.6	23.4	30.6	12.6	17	1770	2.2	8.3	25.8	17.5	26.5	13.0
	4	3	390	3.3	10.0	33.0	23.0	33.0	14.5	17	2000	2.2	5.6	23.5	17.9	39.3	15.1
	1	12	115	4.4	16.7	38.0	21.3	26.3	13.1	12	1315	2.8	11.7	24.1	12.4	23.9	12.2
12	2	21	0	2.3	6.1	26.3	20.2	37.7	16.5	4	1195	1.7	5.0	21.8	16.8	34.0	18.1
	3	1	0	2.8	7.2	31.2	24.0	38.9	14.4	12	720	3.9	12.8	30.6	17.8	30.5	11.6
	4	3	2000	6.1	18.4	30.6	12.2	33.2	14.5	22	2000	3.9	15.0	28.2	13.2	26.0	14.6
	1	21	2000	3.9	15.0	28.8	13.8	26.0	14.8	7	516	2.2	6.1	21.8	15.7	36.1	15.1
16	2	15	0	2.8	7.8	33.6	25.8	35.9	16.4	9	0	1.1	5.6	22.9	17.3	19.6	15.2
	3	11	730	3.3	10.6	31.2	20.6	31.1	15.9	10	2000	2.8	10.0	24.7	14.7	28.0	14.8
	4	11	0	6.1	16.1	29.4	13.3	37.9	15.6	21	2000	2.2	11.1	28.2	17.1	19.8	11.4
	1	9	2000	4.4	16.7	32.4	15.7	26.3	13.6	21	2000	3.3	12.8	23.5	10.7	25.8	13.5
20	2	4	1423	4.4	15.6	34.2	18.6	28.2	15.2	15	2	2.8	8.9	28.8	19.9	31.5	12.9
	3	8	2000	3.9	12.2	28.8	16.6	32.0	11.6	6	2000	2.8	10.6	26.4	15.8	26.4	12.2
	4	15	2000	5.0	17.2	34.9	17.7	29.1	12.0	6	2000	3.3	11.1	21.2	10.1	29.7	12.5
	1	24	2000	4.4	16.1	31.8	15.7	27.3	12.6	7	1700	3.9	12.8	31.8	19.0	30.5	13.5
24	2	12	2000	4.4	16.7	29.4	12.7	26.3	13.5	4	2000	3.3	12.2	22.3	10.1	27.0	13.2
	3	9	639	4.4	13.9	29.4	15.5	31.7	12.6	9	2000	3.9	12.2	24.7	12.5	32.0	12.8
	4	17	0	2.8	10.0	27.6	17.6	28.0	17.1	24	2000	3.3	10.0	18.4	8.4	33.0	17.5
	1	10	70	5.6	15.6	27.0	11.4	35.9	13.2	7	2000	3.9	11.7	18.9	7.2	33.3	13.6
28	2	23	340	5.0	17.2	32.4	15.2	29.1	13.0	19	0	3.9	13.3	23.5	10.2	29.3	13.1
	3	19	2000	5.6	16.7	35.8	19.1	33.5	12.0	1	2000	4.4	14.5	28.2	13.7	30.3	12.0
	4	12	0	5.0	15.6	29.4	13.8	32.1	17.1	6	0	3.9	12.8	22.9	10.1	30.5	17.8

*Group No. 1 = tall heavy, 2 = short heavy, 3 = tall light, 4 = short light.
†For statistical analyses, values were calculated for this hose which the wearer lost.

eight hours per day, wore these hose with their uniforms. Hose worn one day were collected the next day and brought to the Bureau of Home Economics for laundering, where they were also given necessary minor repairs.

A daily record was kept of the hose washed as well as of the area and type of repair needed (Fig. 2-A). Hose which appeared to have had abnormal wear or to which accidents had happened were not used for laboratory test purposes.

In the laundry procedure 23 hose were placed in each mesh bag and were washed in a vacuum-cup type home washing machine. The laundry method included one 6-minute suds at 30° C. with 300 ml. soap, one 10-minute suds at 70° C. with 150 ml. soap, four 5- to 6-minute rinses at 60° C., and a final 5-minute rinse in cold water. Only softened water and liquid soap were used throughout. The latter was made by dissolving 175 gm. of neutral chip soap in 2 liters of softened water. The hose were cen-

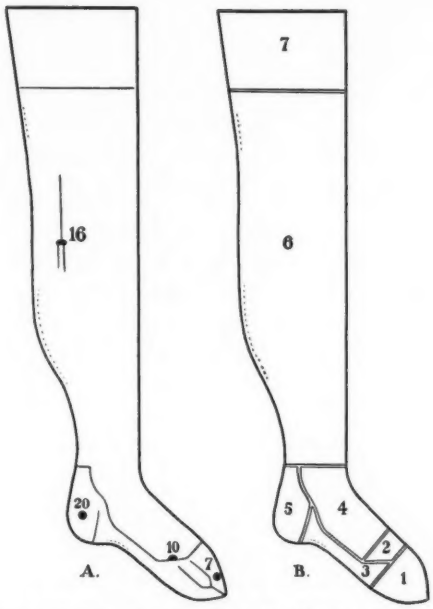


Figure 2—A, Sample wear chart indicating breaks on left side of a hose; B, chart divided into areas of wear.

trifuged after each suds and rinse. They were hung over smooth metal rods and allowed to dry at room temperature overnight.

The student nurses were divided into four groups of 17 each, on the basis of height and weight: group 1, tall heavy (over 64 inches and more than 122 pounds); 2, short heavy (under 64 inches and more than 122 pounds); 3, tall light (over 62¾ inches and under 122 pounds); and 4, short light (under 62¾ inches and under 122 pounds). At regular intervals of four periods of wear and laundering, hose of all four constructions were taken for laboratory analysis from four girls, one in each of the four groups.

At any test period one hose of a pair was used for bursting strength, elongation, wale and course count, and fluidity in cuprammonium hydroxide. The other hose was used for determining elastic properties by the Frazier test. Five bursting strength samples were taken from the leg portion in such a way that no courses were duplicated; two were taken to the left of the center fold, two to the right, and the fifth on the center fold at the ankle section of the hose. Wales and courses were counted on the area used for bursting strength. One sample for the fluidity determination was taken on the center fold of the leg just above the fashion marks, and the other sample for the fluidity determination was cut from the sole reinforcement worn under the ball of the foot. The foot of the hose tested for elastic properties was unraveled in order to determine the weight distribution.

Physical tests were conducted in a laboratory maintained at 70° F. and 65 per cent relative humidity, according to the methods reported by Hays, Petersen, and Taylor[7]. Hose were tested after the preliminary wash and at regular intervals of 4 days' wear. In this preliminary wash the methods outlined under laundry procedure replaced the usual wash in the Launderometer prior to testing[7]. The hose of the 90/2 yarn were tested at nine periods ending with 32 days' wear; whereas those of the 120/2 yarn were tested at eight periods ending with 28 days' wear. The new hose were assigned to groups 1 to 4 by random numbers.

Four measurements, length of leg and foot and width of ankle and welt were made on all the new hose, and to determine the shrinkage the same measurements were repeated on the hose selected for testing at each period. In addition, at each test period the welts were measured before washing.

In making the weight distribution analysis the leg was separated from the foot by removing one course just above the heel reinforcement. The sole, heel, and toe seams were ripped. Beginning at the loose toe course the foot was then completely raveled, keeping the main and reinforcement yarns separate. From the weight of the entire hose and of the foot yarns the amount of main and reinforcement yarn used in the foot was calculated as a percentage of the total weight of the hose.

The fluidity determinations were made on the leg and foot samples of the hose given a preliminary wash and after 8, 16, 24, and 28 days of service and the hose made of 90/2 yarn were also tested after the 32nd day. The fluidities of 0.5 per cent dispersions of the cotton in cuprammonium hydroxide were determined at 20° ± 0.1° C. in 25 ml. buret consistometers of the type described by Herschel and Bulkley[8]. The preparation, storage, and delivery of the cuprammonium solution were in accord with the recommendations of the American Society for Testing Materials[3]. The composition of the cuprammonium hydroxide solution was within the more accurate limits stated by the Amercian Society for Testing Materials[3]. The consistometers were calibrated according to the method of Herschel and Bulkley[8] with oils of known viscosity obtained from the National Bureau of Standards. The capillaries had an average inside diameter of 0.0963 cm. and an average length of 2.49 cm. The procedure employed for determining the fluidity of the cotton in cuprammonium hydroxide was essentially the same as that described by the American Society for Testing Materials[3] with the modification that the time of flow was obtained by means of a "split second" stop watch for 5 ml. portions of the cuprammonium-cellulose suspensions.

The calculations of F, the fluidity, were made according to the method suitable for plastic materials and adapted to cellulose suspensions in cuprammonium hydroxide by Downey and Elmquist[12]. In the formula $F = \frac{q}{C\,(P-p)}$, Herschel and Bulkley[8] defined p as "the pressure obtained as the intercept of the upper straight portion of the graph, prolonged, on the axis of the abscissa" when the pressure head, P, is plotted as abscissa and the rate of flow, q, as ordinate. The location of the upper straight portion of

the graph obtained by plotting the five values for each of the 5 ml. portions in the 25 ml. consistometer was often quite uncertain because of the curvature of the graph due to the properties of the plastic material. In order to be more definite, the equation of the straight line through the second, third, and fourth values of the 5 ml. portions (the first and fifth portions were considered to be less accurate) was calculated by the method of least squares because this is more accurate than the visual graphic method. The intercept of this line on the pressure axis was calculated and used as p.

RESULTS

In a study of this type with so many variables involved it is impossible to determine which factors are most important unless the data are analyzed systematically. While length of service is probably the largest factor, differences in the individual wearers, types of shoes worn, nonuniformity of the new hose, and accidents during wear are other variables. Therefore various statistical methods were employed in the determination of some of the significant variations and relationships in these four constructions of hose.

The number of wales per inch of fabric decreased as the hose were worn (Table 2). This indicates an increasing permanent distortion of the leg of the hose. As would be expected the number of courses had an upward trend.

Bursting strength in general decreased as service progressed for all four constructions of hosiery. Constructions A and B were stronger at the end of 32 periods of wear than were constructions C and D when new. Small fluctuations existed from one test period to the next so the analysis of variance was used. As reported in Table 4, two sources of variation, service and yarn number, were highly significant.

Bursting strength is considered by some to be a measure of fabric strength in the direction of the courses[5]. Therefore scatter diagrams were made to determine the covariance of bursting strength with wales, with courses, and with wales plus courses. The wales and courses had been counted in the exact area bursted. Since the scatter diagrams for worn hose had no lines of trend, correlation coefficients were calculated only for the new hose. When the hose are new there is high positive correlation between the number of wales and the bursting strength. There is no correlation between the course count and strength for either new or worn hose. Since reducing wales by distortion of any portion of the hose should increase the courses and vice versa, a test for covariance of bursting strength with wale plus course count was made. Again high correlation was found for new hose but the scatter diagram made for worn hose has no line of trend.

The elongation or stretch of the 1¾ inch circle of fabric burst under the force of the 1-inch ball was determined at the time the fabric was broken. This is not a standard test, but it is of interest in a study of this type particularly when other elastic properties are measured. The elongation values are reported in inches rather than in percentage as for breaking strength.

According to the analysis of variance (see Table 4) both service and yarn number are highly significant sources of variation in elongation. However there are great fluctuations, even though these values are the average of 20 recordings, five on each of four hose, at any period of service. The values are less than the original ones after 8 days of wear but increase at 12 days. For three constructions, B, C, and D, the values at certain test periods exceeded the values for the new hose. The two lots of hose of 120/2 yarn have greater elongation after 28 wearings than when new; whereas the two of 90/2 yarn have slightly less elongation than when new, but have as much as the 120/2 after 28 days of wear. However the 90/2 constructions had greater elongation when new than the 120/2 constructions.

TABLE 4
Analysis of Variance of Some Physical and Chemical Tests on Cotton Hose Given Various Amounts of Service

Source of Variance	*D/F*	*Mean Square*[1] *Bursting Strength*	*Elongation*	*D/F*	*Mean Square*[1] *s'-s*	*r/s*	*D/F*	*Mean Square*[1] *Fluidity Leg*	*Foot*
Service	7	1328.91**	0.0185**	7	78.44**	219.01**	4	13.64**	9.98**
Group (by height and weight of wearer)	3	17.12	.0011	3	29.88	6.78	3	.35**	.06
Yarn number	1	21838.10**	.0418**	1	628.35**	116.28	1	.98**	.02
Type of welt	1	16.10	.0000	1	591.68**	245.86*	1	.00	.07
Service x group	21	13.28	.0014**	21	14.19	30.49	12	.22**	.20*
Service x yarn	7	51.73**	.0060**	7	8.30	28.55	4	.08*	.15
Service x welt	7	4.22	.0009	7	4.22	39.17	4	.16**	.11
Group x yarn	3	8.47	.0004	3	14.15	22.64	3	.04	.07
Group x welt	3	4.32	.0006	3	8.58	76.57	3	.08*	.02
Welt x yarn	1	48.13	.0014	1	1.05	134.89	1	.42**	.02
Service x group x yarn	21	27.90*	.0009	21	10.86	33.43	12	.06	.12
Service x group x welt	21	20.10	.0012*	21	7.02	34.42	12	.10**	.05
Service x yarn x welt	7	28.01	.0023**	7	8.10	35.23	4	.01	.10
Group x yarn x welt	3	29.31	.0003	3	17.89	4.78	3	.03	.05
Service x group x yarn x welt	21	21.21	.0009	21	12.68	38.44	12	.02	.06
Error	512	16.93	.0007						

[1]One asterisk indicates a significant variation; that is, one which probably will occur 19 times out of 20 repetitions of the experiment. Two asterisks indicate a highly significant variation or a probability of 99 times out of 100.

A few significant differences were found between the fluidity values of the new hose but in general the leg and foot sections of the four constructions were similar. The values of the leg portion of the 120/2 stretch hose were the highest when new and throughout service.

The fluidity values of both the leg and the foot samples increased with service, thus showing progressive deterioration. Service was a highly significant source of variation in every statistical analysis of the leg and foot fluidity data.

The height and weight, or group, of the wearer was never a significant source of variation in the fluidity data of the foot samples. In the analysis of variance of the data for leg samples, group was not a significant source of variation for any of the four constructions considered separately; however, when all four constructions were considered together, height plus weight was a highly significant variable (Table 4). Since it was not significant for the individual constructions, the high significance of this source of variation in the combined analysis is due to the fact that group 1 had the highest average value for constructions A, B, and D, and group 3 had the lowest average value for constructions A, C, and D. The remaining values based on height and weight of wearers had no consistent order.

There was a highly significant difference between the fluidity values of the foot and leg samples in the three constructions of hose, the 90/2 plain welt, the 120/2 plain welt, and the 120/2 stretch welt. In these three types of hose, the average fluidity values of the four groups, in the service periods tested, were higher 11 times out of 13 for the leg than for the foot samples. There was no significant difference between the leg and foot values for the 90/2 stretch welt hose.

Yarn number was not a significant source of variation in the comparison of the fluidity data of the 90/2 plain welt leg with the 120/2 plain welt leg, but it was highly significant in the comparison of the 90/2 stretch welt leg with the 120/2 stretch welt leg. The average fluidity values of the leg knit from 120/2 yarn with a stretch welt were definitely higher for all five test periods than for the leg knit from 90/2 yarn with a stretch welt. This difference was approximately the same for the new and worn hose of these two constructions. When all four constructions are considered together, yarn number is a highly significant source of variation (Table 4). This statistical result was obtained because the fluidity values were higher for the new 120/2 stretch welt leg sample. In the fluidity data for the foot samples yarn number never varied significantly.

The type of welt was not a significant source of variation in the fluidity data for either the leg or the foot samples in any of the analyses of variance. Of course, the fluidity samples were taken where the effect of type of welt would be a minimum.

Values for the recovery load at 19.2 inches, r, for the stretch load at 19.2 inches, s, and for the stretch load at 20.2 inches, s′, were read from the Frazier machine charts. From these, s′-s, the increase in load necessary to stretch the hose from 19.2 to 20.2 inches in circumference, and r/s, the recovery-stretch ratio, were calculated. Since it is the latter two values which represent the more interesting and useful physical characteristics of the hose, the statistical analyses were made for those values, which are reported in Table 3.

The three sources of variation of high significance for s′-s were service, type of welt, and yarn number. During service the s′-s values increased at first and then decreased. The 90/2 constructions (A and B) had approximately the same values at the beginning and end. Constructions C and D (120/2) had lower final than initial values. At any test period the values for the plain welt hose were always higher than those for the stretch welt and may explain the preference expressed by the students for the stretch welt hose. The increase in load was greater for the lighter weight hose than for the heavier hose with the same top. This may seem strange until the number of courses per inch (Table 2) of the two weights are considered.

In the r/s comparisons, yarn number is not an important source of variation (Table 4) because r/s is a ratio measuring how well the hose recover from stretching, and the variation due to yarn is included in both r and s. The type of welt had significant variation for all four constructions analyzed together, highly significant for the 120/2 hose, and not significant for the 90/2 constructions. The variation due to service is highly significant for all four constructions considered together (Table 4), for constructions C and D together, and for construction C alone. It is also significant for A and for A and B together. However for this ratio, service is not important for either weight of hose with a stretch welt, constructions B and D.

Distortion of the welt during wear might be expected to correlate with the increase in stretch load necessary to distend the hose from 19.2 to 20.2 inches in circumference (s′-s), and/or the recovery stretch ratio, (r/s). However, scatter diagrams of s′-s values or r/s values plotted against the circumferences of welts, measured prior to the final laundering, show no lines of trend.

Stretch endurability, or the number of cycles the hose withstood before breaking, is reported in Table 3. The maximum number of cycles, to which any hose was subjected, was 2000[7]. Since this restriction was imposed, no statistical analysis was made on these data.

The length of the leg of the hose tended to decrease as service increased and sometimes was as much as 3 inches shorter. The foot shrank ¼ to ¾ inches in the preliminary laundering, but with wear increased to approximately the original length. The width of the ankle increased progressively for all four constructions up to and including the 16 or the 20 wash period, after which it decreased. At the 20 wash period the ankle was ¼ to 1 inch larger than the new hose. The welt, which shrank initially, tended to stretch with service and at the end of service was as large or larger than when new.

The hose were weighed when new and test hose were weighed again before other laboratory tests were made.

Any darns were picked out before weighing. Nearly all the hose increased in weight, even those worn as many as 28 and 32 days. Since the weight of the hose given only the preliminary wash also increased, it is probable that a small amount of soap was retained. Therefore change in total weight could not be used as a measure of wear.

Four hose of each construction were raveled when new to determine the relative weights of the main and reinforcement yarns in the foot, and of the yarn in the leg to the total amount in the hose. It was believed that if this procedure were repeated for the worn hose, the change in percentage would be an indication of the degree of wear, particularly of the foot section. It was almost impossible to keep the two yarns used in the foot separate if the hose being raveled had any holes. In addition, it was very difficult to ravel worn hose, because the yarns were weaker and clung together. When a few hose from various test periods were unraveled and weighed, the distribution was within the range of the new hose of corresponding construction. Since the test was not giving any pertinent information relative to the wearing qualities of the hose, it was discontinued.

A hose was divided into seven areas as indicated in Figure 2-B. The time a repair was needed in any area was tabulated by the period in which it occurred. These were chosen to correspond with the test periods; two additional intervals, 33 to 40 washes and 41 to the time of discarding, were added. For constructions A and B more repairs were needed in area 1 than in area 2, while for constructions C and D more mending was required in area 2 than 1. For the first two lots area 1 was knit from two yarns of 90/2 and the latter two constructions from one yarn of 120/2 and one of 90/2. Area 2 was not reinforced so the fabric was knit from 90/2 (A and B) and 120/2 (C and D) yarn. Many breaks occurred in section 2 next to the heavier fabric of section 1. This was especially true for the lighter weight hose.

When the data for all hose in the study were tabulated, each lot included different numbers of hose with different amounts of service. For this reason, in order to make a comparison of the different constructions, repairs on hose tested up to 28 washes inclusive were then tabulated (see Fig. 3). For this comparison 28 pairs of hose in each construction were used. The hose were worn from 4 to 28 days before removal for testing. As shown in Figure 3 constructions B and D with stretch welt required more repairs than A and C with plain welts. The toe sections, areas 1 and 2, were mended more often than the heel section, area 5.

It is well known that the time of discarding hose varies considerably between individuals as well as between pairs of stockings. For this study there was a low of 5 days and a high of 58 days with the maximum range for any one construction being 42 days (Table 5). The girls had the privilege of indicating when they considered a hose no longer wearable, but in every case the hose were removed when in the opinion of the laboratory worker they

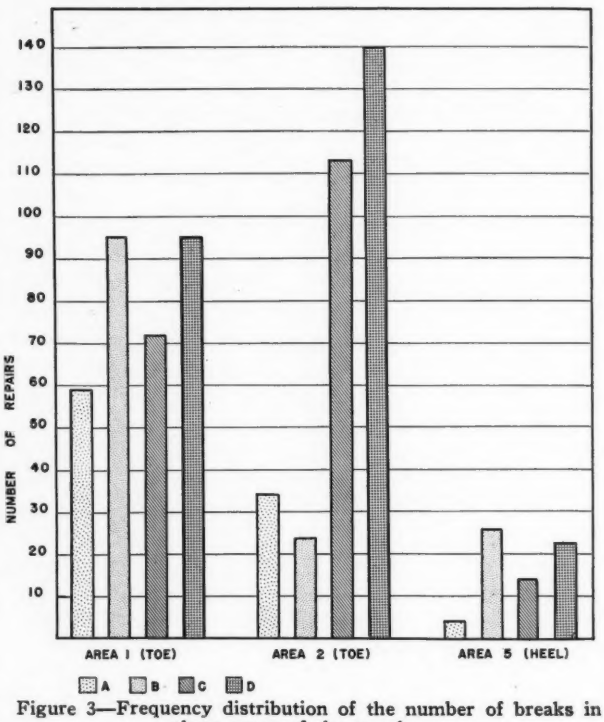


Figure 3—Frequency distribution of the number of breaks in three areas of the test hose.

TABLE 5
Time of Discard for Four Constructions of Cotton Hosiery

Time of Discard	*Construction*			
	A	*B*	*C*	*D*
Range (days)	12–54	19–58	9–41	5–44
Average (days)	31.0	33.7	23.2	22.4
Number of hose averaged	35	34	58	51
Standard deviation	10.48	10.55	7.07	9.44

were no longer serviceable. No distinction is made in Table 5 between hose discarded because of accidents and those with normal wear.

Both the plain and stretch welt hose of 90/2 yarn wore longer than those of 120/2 yarn. However, the effect of type of welt on length of service is not conclusive from the number of hose available for this study. The students' preference for the less durable, lighter weight, 120/2 constructions was due, no doubt, to the appearance of the hose.

The average length of service was 31.0, 33.7, 23.2, and 22.4 days for constructions A, B, C, and D, respectively. Since the latter two had a shorter span of life, more replacements were made and more hose of those constructions were worn out (Table 5). The standard deviations were 10.48, 10.55, 7.07, and 9.44 days, respectively. In consumer wear studies accidents occur, so a large number of samples are necessary to give an accurate value for the average length of life. For example, construction D had a shorter average length of service than construction C even though some individual pairs lasted longer. A

(Continued on page 495)

PROCEEDINGS OF THE

American Association of Textile Chemists and Colorists

SEPTEMBER 15, 1941

Officers of the Association

CARL Z. DRAVES, *President*
General Dyestuff Corp., New York, N. Y.

ROLAND E. DERBY—THOMAS R. SMITH, *Vice-Presidents*

WILLIAM R. MOORHOUSE, *Treasurer*
National Aniline & Chemical Co., Boston, Mass.

HAROLD C. CHAPIN, *Secretary*
Lowell Textile Institute, Lowell, Mass.

LOUIS A. OLNEY
President Emeritus and Chairman of the Research Committee
Lowell Textile Institute, Lowell, Mass.

COUNCILORS
Representing Sections

FREDERIC A. PRISLEY; PETER J. ARIENTE (Rhode Island)
WILLIAM EBERSOLD; CHARLES A. SEIBERT; WILLIAM A. STRINGFELLOW (Philadelphia)
HENRY F. HERRMANN; GEORGE L. BAXTER; HAROLD W. STIEGLER (New York)
DEXTER R. KNEELAND; CLARENCE L. NUTTING; (N. New England)
H. E. KIEFER, JR.; A. HENRY GAEDE (Piedmont)
ROBERT W. PHILIP (South Eastern)
J. D. MOSHEIM (South Central)
VIRGIL T. HARTQUIST (Midwest)

Past Presidents

ELVIN H. KILLHEFFER; P. J. WOOD; ROBERT E. ROSE; WILLIAM H. CADY; ALBAN EAVENSON

Local Sections and Their Officers

Northern New England Section

John N. Dalton, Chairman, Pacific Mills, Worsted Division, Lawrence, Mass.
Edward S. Chapin, Secretary, W. C. Durfee Co., Inc., 114 Federal St., Boston, Mass.
Kenneth H. Barnard, Vice-Chairman; John H. Grady, Treasurer

Rhode Island Section

Ben Verity, Chairman, Carbic Color & Chemical Co., 68 Pine St., Providence, R. I.
Iver W. Fallstrom, Secretary, Arnold Hoffman & Co., 55 Canal St., Providence, R. I.
Howard V. King, Vice-Chairman; R. R. Farwell, Treasurer

New York Section

Harry R. Tisdale, Chairman, American Dyewood Co., 22 East 40th St., New York, N. Y.
Norman A. Johnson, Secretary, American Dyestuff Reporter, 440 4th Ave., New York, N. Y.
P. J. Kennedy, Vice-Chairman; Edward H. Schmidt, Treasurer

Philadelphia Section

John F. McCoy, Chairman, Edgewater Dyeing & Finishing Co., 4080 Frankford Ave., Philadelphia, Pa.
James P. Conaway, Secretary, 5947 Belden St., Frankford, Philadelphia, Pa
A. E. Jones, Vice-Chairman; George E. Kohn, Treasurer

Piedmont Section

L. M. Boyd, Chairman, Scholler Brothers, Inc., Salisbury, N. C.
T. W. Church, Vice-Chairman; R. D. Howerton, Treasurer
D Stewart Quern, Secretary, Becco Sales Corp., 1000 West Morehead St., Charlotte, N. C.

South Central Section

Fletcher L. Kibler, Chairman, United Hosiery Mills, Chattanooga, Tenn.
Frank F. Myers, Secretary, Geigy Co., Inc., Chattanooga, Tenn.
Jack Anderson, Vice-Chairman; J. T. Bohannon, Treasurer

Midwest Section

Archie G. Alexander, Chairman, Phoenix Hosiery Co., 320 East Buffalo St., Milwaukee, Wis.
J. Gordon Stott, Secretary, Ciba Co., Inc., 325 West Huron St., Chicago, Ill.
F. L. Wilhelm, Vice-Chairman; J. S. Morrison, Treasurer

South-Eastern Section

Perrin N. Collier, Chairman, Callaway Mills, LaGrange, Ga.
Curt Mueller, Secretary, Bibb Mfg. Co., Macon, Ga.,
L. L. Bamberger, Vice-Chairman; A .R. Macormac, Treasurer

Lowell Textile Institute Student Chapter

Ernest Peter James, Chairman, Stanley Szopa, Secretary.

North Carolina State College Student Chapter

William S. Pearson, Chairman; George W. Funderburk, Secretary

Philadelphia Textile School Student Chapter

Joseph E. Dunson, Chairman; Robert J. Wiley, Secretary

Members should notify the **Secretary** immediately of all address changes

REPORT OF THE NOMINATING COMMITTEE

THE Councilors Representing Sections, in their capacity as Nominating Committee, have directed the Secretary to report the following nominations for the election of 1941:

For President—Thomas R. Smith.

For Vice-Presidents—Roland E. Derby and Charles A. Seibert.

Under the Constitution, additional nominations, each signed by at least twenty-five Senior members, filed with the Secretary not later than October eighth, will be given equal standing on the ballot.

Respectfully submitted,

HAROLD C. CHAPIN, *Secretary.*

ANNUAL MEETING AND CONVENTION

Robert A. Bruce
Chairman Reception and Information Committee

The committee on reception and information, headed by Robert A. Bruce, vice-president, Amalgamated Chemical Corp., and assisted by the following: W. L. Barker, National Aniline & Chemical Co., J. Reese Daniel, General Dyestuff Corp., Joe Morton, Morton Chemical Co., Irving Royce, Royce Chemical Co., Howard M. Sprock, Geigy Co., James W. Black, Ciba Co., Henry B. Constable, duPont Co., and Harold P. Goller, Seydel Chemical Co., will be on hand to officially extend the welcome of the Piedmont Section and to give you whatever information you may require concerning the activities at Pinehurst and the beautiful country surrounding headquarters for the 1941 Convention.

Mr. Bruce and his committee should be consulted for information concerning the location and time of the technical meetings, sports activities, transportation schedules, etc. If you play golf and lose your ball in the rough, see Mr. Bruce and his committee for information concerning its whereabouts, but try to keep out of the rough as much as possible because the fairways and greens are much to be desired, although, the rough and out-of-bounds territory will amaze you at Pinehurst.

OCTOBER 31st — NOVEMBER 1st
THE CAROLINA, PINEHURST, N. C.

The Significance and Utility of Cuprammonium Fluidity in TEXTILE BLEACHING*

F. L. FENNELL
R. & H. Chemicals Dept., E. I. du Pont de Nemours & Co., Inc.

INTRODUCTION

THE determination of the apparent fluidity of solutions of cellulose in cuprammonium has been described by many workers since Ost, in 1911, made the first published attempt to secure quantitative data. Considerable work has been done in an effort to standardize and simplify the method of making the test, since its significance has long been recognized by students of cellulose chemistry. At the present time, the test is used widely in one form or another in the rayon and pulp industries as a routine control test. In the textile industry, however, several facts have combined to hinder the widespread adoption of this test as a standard test for control and specification of textile quality. Our laboratories have found that the fluidity test is a very useful tool in the investigation of a large variety of processing problems and have applied it to an increasingly large number of samples during the last five years.

It is felt that a discussion of the practical significance of this test and a comparison of the results with the results of more widely used tests will be of value. Such data as are included are only representative of a much larger accumulation of results which have been obtained, and these are presented to give a somewhat clearer conception of the value and of the limitations of the test.

THEORETICAL

The fluidity of a solution or a liquid is a measure of the ease with which the material flows. It is the reciprocal of the viscosity, which is the resistance to flow or the internal friction of the fluid. Fluidity is expressed in reciprocal poises or rhes.

A good conception of the reason for the close relationship between the quality of the cellulose and the fluidity of its solution may perhaps be obtained by considering a somewhat simplified theoretical picture. Grey cellulose material, material that has not been chemically processed. may be considered as consisting of many long chain cellulose molecules. When the cellulose is treated with an acid, an alkali, or an oxidizing agent so as to "degrade" it, these long chain cellulose molecules are broken down into a larger number of shorter chains. The degree of severity of the treatment determines the extent of the shortening of the chain; and the average length or size of the chains determines the fluidity of the cellulose in cuprammonium solution, the long chain molecules being less mobile than the short chain molecules. Briefly, solutions of untreated cellulose material having a large proportion of long chain molecules will have a low fluidity, whereas severely treated cellulose material containing excessively large amounts of short chain molecules will produce solutions with high fluidities.

It should be remembered that these molecules, relatively large though they may be, are still submicroscopic in size. The fluidity will be negligibly affected by any mechanical effects, such as cutting with shears or even grinding. The usefulness of this test depends to a large extent upon the fact that the result is practically independent of the mechanical condition of the sample under consideration, and that it depends upon the chemical condition, which reflects the severity of the chemical treatments to which the sample has been subjected.

METHOD OF TESTING

It is necessary to dissolve or disperse the cellulose before its fluidity may be determined. It is further necessary to choose a solvent or dispersing agent which will not degrade the material in the process of dissolution, or which will uniformly degrade all materials in proportion to the original size of the molecules. Cuprammonium hydroxide solution is one of the few solvents to meet the requirements of this test. It is hardly an ideal solvent since it is unstable, subject to variation in composition, comparatively difficult to prepare, and requires special precautions in storage.

Dissolving the cellulose sample in the solvent requires a special technique. High grade celluloses are more difficult to dissolve than more highly degraded materials. It is further necessary to protect the cellulose from any degrading influences while it is being dissolved. Finally, special viscometers for determining the fluidity of the solution must be prepared and calibrated, and the determination must be carried out with careful temperature control.

Much of the work which has been published has been concerned with improving, simplifying, and standardizing the conditions of the test. Clibbens and Geake contributed to this work, and the conditions specified by them have been used to an increasing extent by other workers in this field with little modification. The A.S.T.M. method and

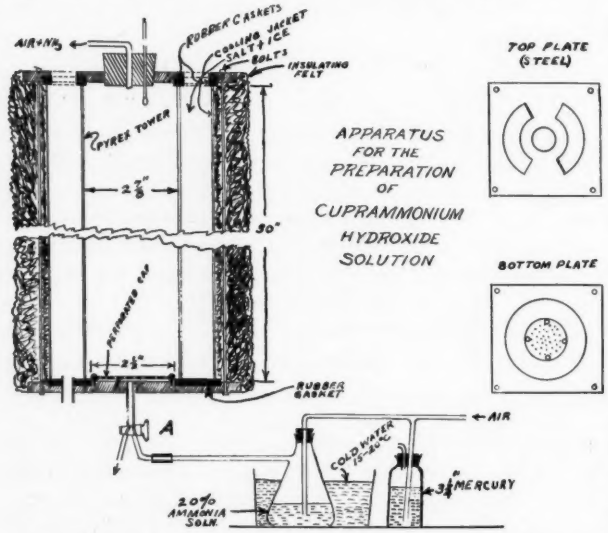
*Presented at meeting, Rhode Island Section, May 23, 1941.

the method of R. T. Mease of the National Bureau of Standards are essentially the same. The inherent difficulties of the test have been minimized and the conditions have been so effectively standardized that, with reasonably good care in technique and selection of equipment, reproducible and highly significant results may be obtained.

To determine the fluidity, the sample must first be cut or shredded into small pieces. The moisture content should be known, as should the amount of foreign and sizing materials, so that a known amount of dry cellulose may be weighed out for the test.

Sizing materials may have two effects on the fluidity. Less cellulose may be weighed out than is required, unless consideration is given the quantity of sizing materials, and the sizes may in themselves be viscous enough to affect the fluidity of the solution which is prepared. We have found that the effect is insignificant from a practical standpoint in most cases. The possibility of a sizeable error must be considered, especially if comparatively high amounts of foreign material are present.

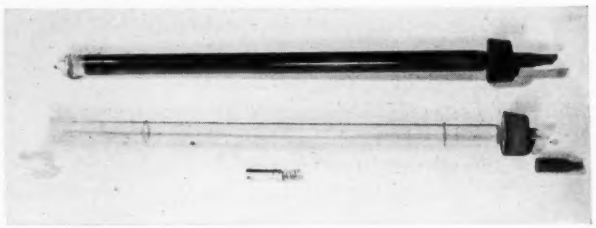
The cuprammonium solution is prepared by bubbling air saturated with aqua ammonia vapor through an ammonia solution containing a slight amount of sugar in the presence of copper. The copper is oxidized and dissolved to form cuprammonium hydroxide. Various forms of equipment are used; we use a tower filled with purified copper wire and fitted with a perforated plate for this purpose.



After sufficient copper has dissolved, the solution is analyzed and the concentrations of copper and ammonia adjusted to 15 ± 0.1 g./L. and 200 ± 5 g./L., respectively. An analysis for nitrites is also made to assure that they will not interfere with the test.

The cuprammonium solution must be stored cold, in the absence of light, and must be retained in a well-stoppered container to prevent loss of ammonia and reaction with the air. Periodic analysis is made of the stored material to assure that it remains within the specified limits of concentration.

In order to assure that the cellulose in solution is not exposed to the oxidizing influence of the air, the sample is dissolved in a tube which is completely filled with cuprammonium solution. The tube carries a capillary which is of the proper size and after the sample is dissolved the solution is allowed to flow through this capillary tube and the time of flow noted. No transfer to a separate viscometer is required and oxidation is thus avoided at this point.



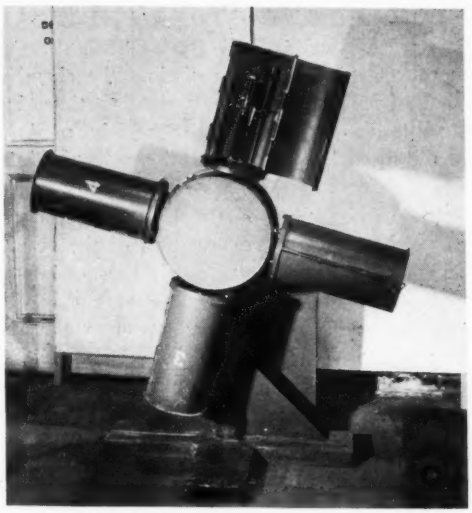
Viscometer

This viscometer must be carefully constructed to the dimensions specified in the literature to assure that results will be obtained which may be reproduced with other instruments. Each viscometer must be carefully calibrated to determine the time of flow at 20.0 ± 0.1° C. of solutions of various fluidities; from the data obtained. a calibration curve may be made for each instrument so that the fluidity corresponding to any time of flow may be determined. In addition, the total volume of solution contained in each viscometer must be determined. From these figures the proper amount of cellulose to weigh out for each instrument may be calculated very readily. The viscometers are provided with small steel plungers carrying a coil spring on one end. These serve to agitate the solution as the viscometer is turned end over end.

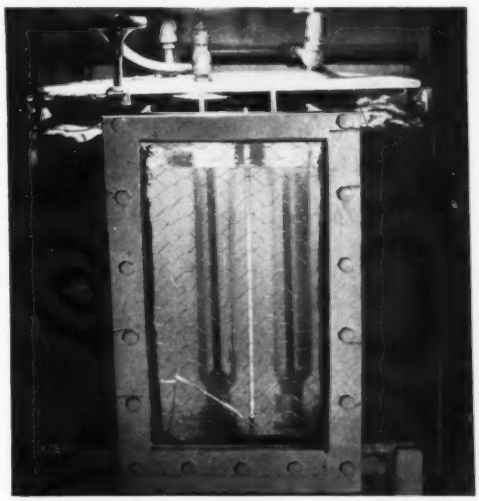
In order to dissolve the cellulose, the viscometers, containing the proper amount of cellulose, the steel plunger, and filled with cuprammonium solution, are placed in the "windmill" agitator.

This agitator is so arranged that the viscometers are securely held in position and the solution is not exposed to the light. The rate of rotation is such that the steel plunger will have time to travel from one end of the viscometer to the other before the viscometer is inverted. The containers rotate on their longitudinal axes so that any cellulose adhering to the sides of the tube is removed. Since high quality celluloses require about 18 hours' agitation to assure complete dispersion, we rotate all of the samples overnight in the viscometer.

When dispersion is complete, we place the viscometers, two at a time, in a constant temperature bath. The rubber tube sealing the capillary is removed before the instrument is set in place. This bath is so arranged that one sample can be coming to temperature while the cellulose solution is flowing out of the viscometer. The temperature is



"Windmill" Agitator



Constant Temperature Bath

carefully adjusted to 20° C. ± 0.1° C. by adding ice to the bath as required. Agitators are provided to assure that the water is uniform in temperature. After the viscometer has reached the required temperature (about 10 mintues are required), the glass stopper is removed and the time required for the level of solution in the viscometer to fall from the top calibration mark to the lower one is recorded. From the calibration curves, the fluidity is then readily determined.

Usually two to three days are required to complete the test. Of course, all of this time is not spent in actively working with the samples. One day is required to condition the samples or determine the moisture content after they have been cut into small pieces. The samples are weighed out, the viscometer filled, and the instruments placed in the agitator on the following day. On the third day the time of flow is determined. The number of determinations which may be made in one day depends primarily on the number of viscometers available. We are equipped to make from 12 to 16 determinations a day, if necessary.

CLASSIFICATION OF CELLULOSES

By a careful interpretation of the results of a series of fluidity determinations, we are able to classify the samples into groups indicating the relative damage to the material. The Fabrics Research Committee of the Department of Scientific and Industrial Research (G.B.) has published a table classifying cellulose materials according to their fluidities. This table is reproduced in part as Table I.

Many groupings may be made within the limits of each group in this table. In any case, the higher the fluidity, the more highly degraded is the cellulose. In our opinion, based on a large number of tests, no textile mill should turn out cotton materials with a higher fluidity in ½ per cent solution than 10 reciprocal poise, and most cotton textiles should have lower fluidities.

TABLE I

Classification of Cellulose Materials According to Their Fluidities

Class	*Fluidities of 0.5% Cellulose Solution in Cuprammonium (Reciprocal Poise)*	*Cellulosic Materials Comprising the Class*
1	1- 5	Very mildly prepared (scoured or scoured and bleached) cottons.
2	5-10	Normal scoured and bleached cottons; unbleached pulps.
3	10-20	Textile cotton whose fibers have suffered significant loss in tensile strength because of chemical degradation; bleached pulp; many surgical cotton "wools."
4	20-30	Badly overbleached textile cotton that has suffered serious loss in tensile strength; heavily bleached pulp.
5	30-40	Cottons which show incipient loss of fibrous structure as a result of chemical attack of cellulose; some rayons.
6	40 and above	Cottons highly degraded by chemical attack, sometimes referred to as "oxy- and hydrocellulose"; rayons, overbleached rayons; ashless filter paper.

TENSILE STRENGTH AND FLUIDITY

The fluidity, dependent as it is on the size of submicroscopic molecules, is readily seen to be independent of many of the factors which influence the tensile strength of cotton textiles. Length of staple, degree of twist of yarn, threads per inch of fabric, count, and construction, humidity—all of these affect tensile strength test. Although tensile strength depends to some extent on the chemical condition of the cellulose, it is frequently not until a comparatively large amount of chemical degradation has occurred that the chemical condition becomes a large enough factor to affect the results of the strength test. Variability in the mechanical construction of a fabric may mask the effect of chemical tendering. With the fluidity test, incipient chemical damage which may lead to subsequent premature failure of the material may be detected.

SERVICE LIFE AND FLUIDITY

Exposure to weathering, perspiration, and washing processes, among many other things, inevitably lead to chemical degradation of a fabric during its service life. Obviously the better the original chemical condition of the fabric, the longer it may be expected to render satisfactory service. Of course, it is possible that the material may be subjected to mechanical stresses which are greater than those for which it is designed, and its failure may occur before chemical tendering exerts any appreciable influence. It is evident that fabrics can be reduced in tensile strength by wear and abrasive action in the absence of chemical exposure, or that they can be reduced in strength by chemical means in the total absence of mechanical influences.

With materials of proper design and construction, barring accidents, the lower the initial fluidity, the longer will be the service life.

Evidence that the fluidity of the material as it is put into service is of value in predicting the serviceability of the material may be obtained by consideration of the following example.

TABLE II

Effect of 20 Launderings on Sheetings Prepared in Different Manners

	Tensile Strength			Fluidity	
Sample	*Before Laundering*	*After Laundering*	*Per Cent Change*	*Before Laundering*	*After Laundering*
A	135.2	140.1	+ 3.6	6.75	13.4
B	155.9	105.5	—32.3	12.6	22.5
C	148.3	150.2	+ 1.3	4.5	9.65
D	167.5	128.8	—23.1	9.9	15.6
E	163.0	143.3	—12.1	3.48	8.20
F	155.0	117.1	—24.4	15.9	18.5

Each pair of samples (A&B, C&D, E&F) was pretreated in the same manner, then various bleaching treatments were given to bleach samples to the same degree of white. The initial strength, dependent upon shrinkage to a large extent, was shown to be largely dependent upon the pretreatment in this case, and these samples were obtained in the course of the study of the effects of the pretreatments. On the basis of the original fluidities it was predicted that samples A, C and E would better resist laundering action and portions of these were subjected to twenty washings, equivalent to about one year's normal service. This prediction was fulfilled, as will be noted by examining the tensile strength losses encountered. The tensile strength of the original fabrics did not necessarily indicate the resistance to chemical tendering, but rather was closely associated with the initial degree of shrinkage. In two cases, an actual gain in tensile strength was shown after laundering.

The importance of examining and carefully specifying the chemical condition of the product is clearly shown, not only by this test, but by many others in our files.

FLUIDITY AND OTHER CHEMICAL DEGRADATION TESTS

Numerous tests designed to disclose the chemical condition have been proposed from time to time, but only two quantitative tests have been widely used; copper number and methylene blue absorption values. Both suffer from the fault, not existant with the fluidity test, that a very detailed knowledge of the history of the material is necessary before any interpretation of the results may be made, and that subsequent steps in a process may mask the ill effects produced by one too-severe step.

The copper number is dependent upon the reducing properties of the material under test. Degraded cellulose may be in the form of either or both oxy-and hydrocelluloses, but both of these may have their reducing property altered or completely lost if they are treated subsequently in an alkaline solution.

The value of the methylene blue absorption test is limited by several factors, one of which is the fact that certain modified celluloses possess no higher absorption values than normal cellulose. The absorption of methylene blue is also affected by the amount and alkalinity of the ash, by the presence of other foreign materials, and to a large extent upon the pH of the methylene blue solution.

We do not mean to infer, from the foregoing statements, that other tests for degradation may not be of value in certain cases. It is quite generally recognized that this test is quite important.

R. T. Mease of the National Bureau of Standards states the case very well when he says, "The apparent fluidity . . . has been found to be a much more sensitive and precise measure of the changes in the quality of cellulose brought about by the action of light, heat, laundering, and chemicals, particularly in the earlier stages, than is afforded by other methods." ("Measurement of The Apparent Fluidity of Dispersions of Cellulose in Cuprammonium Solution," R. T. Mease, J. Nat. B. of Std., Vol. 22, March 1939, P. 271, RP1179). The difficulties of the measurement are not to be minimized. "The preparation, preservation, and handling of the unstable cuprammonium solution, the construction and calibration of viscometers, the dispersion of high grade cellulose, and the adequate control of temperature while the measurements are made require special equipment and technique. The reliability of the results obtained is determined by the precautions taken in the experimental details, the omission of any of which may lead to erroneous results or complete failure" (Ibid., p. 272). As we have pointed out, however, these difficulties are largely overcome by carefully standardizing the conditions of the test and the results of proper tests have been established as highly significant in numerous instances.

APPLICATION IN THE INSTALLATION OF NEW OR IMPROVED PROCESSES

To the bleacher the fluidity test offers a new and valuable tool in determining the relative merits of each of

several processes.

As an example of such a comparison, consider the following data:

TABLE III-A

Treatment	*Fluidity*
Grey (no treatment)	1.27 rhes.
5% NaOH boil (1)	2.26 rhes.
Soda ash boil (2)	2.65 rhes.
Good formula*	3.48 rhes.
Poor formula*	15.90 rhes.

*Bleach after treatments (1) and (2)

It is obvious which process is to be preferred. With a material as high in fluidity as the "Poor" sample, the tensile strength would probably lead to the same conclusion as the fluidity test. In general, with an increase in fluidity from 1 to 10 rhes, little or no loss in tensile strength will be observed. An increase from 10 to 15 rhes. will usually be accompanied by an appreciable tensile strength loss.

The fluidity test can also be used to good advantage as a control for each step in a process, showing the degree of damage for each treatment. For example, consider the following table:

TABLE III-B
Sheeting

Treatment	*Fluidity*
1. Grey	2.8 rhes.
2. Malt and sour	2.9 rhes.
3. Same as 2, then caustic boil	3.4 rhes.
4. Same as 3, then second caustic boil	3.7 rhes.
5. Same as 4, then bleached	3.9 rhes.
6. Same as 5, finished	4.7 rhes.

It will be noted that each step in the process slightly increases the fluidity of the sheeting. The comparison between sample 5 and 6, incidentally, indicates the effect of the presence of large amounts of sizing materials. The ordinary amount of sample was weighed for this test with the result that less cellulose was dissolved than is required by the test, and the solution was too weak to give the proper results. Desizing of sample 6, taking care to avoid any degradation in the process, would have given a sample which would have shown essentially the same result as that obtained on sample 5.

It will be noted in many cases that the oxidation or bleaching process has the greatest effect on the condition of the sample. This is illustrated in the following case:

TABLE III-C
Heavy Sheeting

Treatment	*Fluidity*
1. Grey	2.0 rhes.
2. Soured, neutralized	2.2 rhes.
3. Double caustic boiled	2.9 rhes.
4. Same as 3, then soured	3.0 rhes.
5. Bleach on 4	5.4 rhes.

The fluidity rose more than twice as much on bleaching as it did in all the previous processing of the sample. This is a rather general effect. The degree of bleaching required determines to some extent the severity of bleaching treatment. The broadcloth in the following example was comparatively difficult to bleach, and the heavier treatment required is reflected in the increase in fluidity on bleaching.

TABLE III-D
Broadcloth

Treatment	*Fluidity*
1. Grey	1.04 rhes.
2. One caustic boil	1.45 rhes.
3. Sour after 2	1.95 rhes.
4. Mercerized after 3	1.81 rhes.
5. Bleached	7.03 rhes.
6. Finished and Sanforized	7.23 rhes.

The fluidity test may be used to good advantage to determine the optimum time of bleaching and thus avoid treatment in excess of that required to produce best results. The information in the following table was obtained in the course of experimental work in a plant which was considering the installation of an improved process.

TABLE IV

Time for Bleaching	*Fluidity*	*Whiteness*
Up to temperature	6.35 rhes.	79.6%
After 1¼ hours	6.85 rhes.	80.8%
2½ hours	7.63 rhes.	80.9%
3½ hours	8.40 rhes.	80.9%
4½ hours	8.85 rhes.	80.9%

Boiled out material was bleached with sodium peroxide-boric acid solution in a kier and samples were removed at the intervals indicated.

It will be noted that the fluidity increases continuously during the bleaching treatment. In this case, however, a full bleach was obtained after 2½ hours time. From a degradation standpoint, it was obviously undesirable to continue the bleaching treatment after the full bleach was obtained.

The importance of considering all phases of a problem must be stressed. Although as we pointed out, the bleaching process usually causes the greatest increase in fluidity when the fabric is prepared, the preliminary treatments may greatly affect the result obtained.

TABLE V

% NaOH	*Boil Out Pressure*	*Fluidity*	*Fluidity After Bleaching**
5	15	1.59 rhes.	9.1 rhes.
3	15	1.58 rhes.	3.96 rhes.
5	3	1.40 rhes.	4.12 rhes.

*All samples bleached in same manner with "Solozone"

In this case, an examination of the fluidities before and after bleaching on the first sample only might have indicated that the bleaching process was at fault. Subsequent tests showed, however, that although samples boiled in different ways had essentially the same fluidities, when subjected to identical bleaching treatments the more severely boiled goods were poorer in quality. Although the harsher boils did not in themselves degrade this material, they apparently rendered it more susceptible to oxidation in the bleaching step.

CONCLUSION

No attempt has been made to indicate all of the applications and possibilities of the fluidity test as practically applied in the solution of numerous processing problems. Indeed, the purpose has been simply to indicate some of these possibilities, to demonstrate that results of practical value are obtainable through careful interpretation of the results, and, perhaps, to stimulate greater interest in the test and promote a wider understanding of the significance of the results.

DISCUSSION

Q. Could anyone have a fluidity test made at any particular laboratory and what would the cost be?

A. We maintain a laboratory and have made many determinations for customers and non-customers. I do not believe there would be any charge.

Q. Is the effect of light important?

A. The viscometers are enclosed and light must be excluded from the windmill agitator.

Q. What is the effect of light?

A. Light would have an effect on the solvent and the fluidity value would vary.

Q. How much of a sample of the original material is taken?

A. The viscometer holds about 22 cc. which means a sample of about 1/10 gram for a ½% solution.

Q. How much of a variation in results is there when running on dyed goods?

A. Our experience has been that we have had no particular trouble with dyed goods. We can test bleached or bleach-dyed cottons and the results are generally comparable.

Left to Right—Harold Dingee, E. L. Moore, Robert C. Anderson and Arthur E. Patton.

OUTING, MID-WEST SECTION

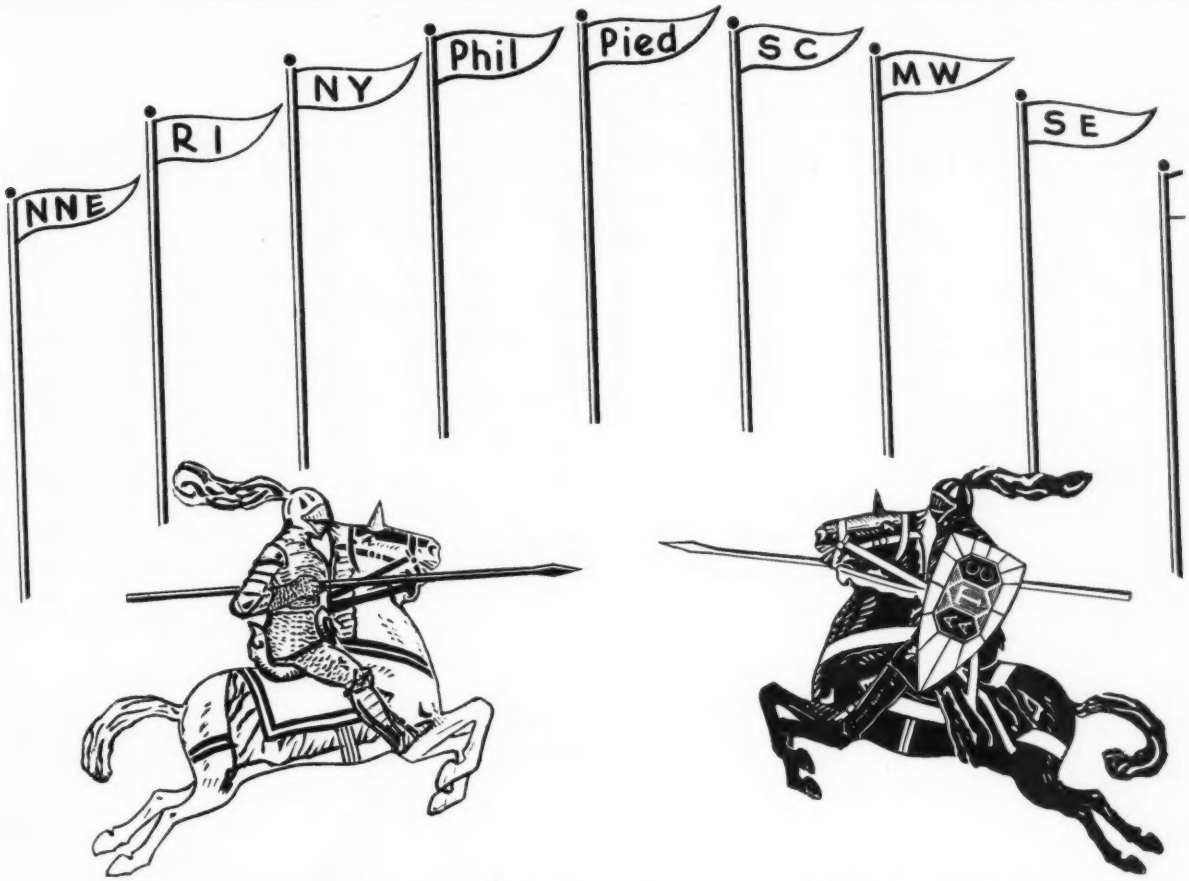
Left to Right—R. E. Sumner, Virgil Hartquist, Robert Griswold, Chairman of the Outing Committee, and Louis Blank.

Left to Right—Herman Stiegler, Archie Alexander, Chairman of the Mid-West Section, John Nerl and Hans Schroeder.

THE Annual Outing of the Mid-West Section was held at Lake Delevan, Wis., on June 14, 1941, with 139 members and guests present. Excellent arrangements by Robert N. Griswold and his committee, good weather, and the large attendance, made this one of the most successful in the history of the Section. In the morning ball game the salesmen beat the dyers, 12 to 8. Lunch was served in the Lake Lawn Hotel. In the afternoon there was a golf tournament, for which the principal prizes went to James Morris for low gross, W. E. Patton for mill man's low gross, and Louis Blank for mill man's low net.

Respectfully submitted,

J. G. Stott, *Secretary.*



Intersectional — Contest

AS previously announced, the intersectional contest will again be a feature of the technical program of the annual meeting and convention to be held in Pinehurst, N. C., under the auspices of the Piedmont Section, on October 31st and November 1st. The contest will take place on Friday afternoon, October 31st. The judges will be announced at a later date.

The contest was introduced for the first time at the annual meeting held in New York in October of last year and it proved to be an outstanding success. Each section presents a paper in competition with the other sections, which papers are based on original, scientific or technical investigations of interest to textile chemists and colorists, either directly or indirectly.

Kenneth H. Barnard, chairman of the Technical Program Committee, has announced that the same rules will be in effect for the contest as were used last year. On a basis of 100 per cent, the judges will allow the following consideration to each of three factors: 50 per cent for general scientific value, 30 per cent for originality or record of discovery and 20 per cent for presentation. The various sections have been hard at work for the past months preparing their various papers. The Rhode Island Section has chosen for its subject: "Textile Chemists Meet the National Defense Emergency." The New York Section will present a paper on "Cotton Fabric Constructions in Relation to Water Resistance." "Relative Exhaustion of Vat Colors in the Pad Pigment Method of Jig Dyeing" is the title of the Piedmont Section entry and the Northern New England Section has chosen for its subject "Prediction and Control of Colored Fiber Blends by Optical Means." Flax will be discussed by the Southeastern Section in a paper entitled: "Progress Report on the Preparation and Processing of Domestic Flax." "Testing Vat Dyed Cotton for Fastness to Hypochlorite Bleach" is the title of the paper to be presented by the Philadelphia Section and the South Central Section has chosen as its subject: "Evaluation of Finishing Agents for Sanforizing."

The winners in last year's contest were as follows: **First**—Rhode Island Section, "The Effect of Modern Finishing Agents on the Light Fastness of Cotton Colors"; **Second**—Southeastern Section, "Some Observations of the Tendering of Vat and Naphthol Dyed Army Duck on Total Exposure to Weathering"; **Third**—Philadelphia Section, "Variables Encountered in Fade-Ometer Testing."

Annual Meeting and Convention
October 31st—November 1st, 1941

TRANSPORTATION
TO ANNUAL MEETING AND CONVENTION

Air • Rail • Bus

AIR

Airplane Schedules to Raleigh, N. C., nearest Airport

From Boston—Leave via American Airlines any one of 28 flights daily as per schedule the day before—no connection the same day. Connect with Eastern Air Lines' flight No. 15, leaving New York 7:45 A.M., Eastern Standard Time—Arrive Raleigh 12:00 Noon.

Return to Boston—From Raleigh Airport—Eastern Air Lines trip No. 14, departing 3:05 P.M., arriving New York 7:15 P.M., connecting with American Airlines trip No. 20, departing New York 7:30 P.M., arriving Boston 8:45 P.M.

One way fare—$38.55—Round trip—$69.30.

From Providence—Leave via American Airlines ay one of 8 flights daily as per schedule the day before—no connection the same day. Connect with Eastern Air Lines' flight No. 15, leaving New York 7:45 A.M., Eastern Standard Time—Arrive Raleigh 12:00 Noon.

Return to Providence—From Raleigh flight No. 14 as above connecting with American Airlines flight No. 24, departing New York at 10:00 P.M., arriving Providence at 11:51 P.M.

One way fare—$36.55—Round trip—$65.70.

From New York—Leave New York Eastern Air Lines' flight No. 15 at 7:45 A.M., Eastern Standard Time—Arrive Raleigh 12:00 Noon.

Return to New York—From Raleigh flight No. 14 as above, arriving New York 7:15 P.M.

One way fare—$26.60—Round trip—$47.80.

From Philadelphia—Leave via Eastern Air Lines' flight No. 15 at 8:50 A.M., Eastern Standard Time—Arrive Raleigh 12:00 Noon.

Return to Philadelphia—From Raleigh flight No. 14, departing 3:05 P.M., arriving Philadelphia 6:20 P.M.

One way fare—$22.45—Round trip—$40.00.

From Washington—Leave via Eastern Air Lines' flight No. 15 at 10:05 A.M., Eastern Standard Time—Arrive Raleigh 12:00 Noon.

Return to Washington—From Raleigh flight No. 14, departing 3:05 P.M., arriving Washington 5:00 P.M.

One way fare—$14.40—Round trip—$25.90.

***From Norfolk*—Leave via Pennsylvania Central Airlines' flight No. 131-142—7:00 A. M. Arrive Raleigh 8:13 A.M.**

Return to Norfolk—From Raleigh—Pennsylvania Central Airlines—flight No. 141-132 departing 3:33 P.M., arriving Norfolk 4:46 P.M.

One way fare—$8.80—Round trip—$15.85.

From Atlanta—Leave via Eastern Air Lines' flight No. 18, 11:10 A.M., flight No. 12, 4:50 P.M., or flight No. 2, 2:45 A.M.—arriving Greensboro 1:45 P.M., 6:45 P.M. anl 5:00 A.M. respectively.

Return to Atlanta—From Raleigh—Pennsylvania Central Airlines flight No. 131-142 departing 8:53 A.M., arriving Greensboro 9:17 A.M., connecting with Eastern Air Line trip No. 25 leaving Greensboro at 12:25 P.M., arriving Atlanta 2:40 P.M.

One way fare—$18.60—Round trip—$33.50 (To Greensboro).

One way fare—$22.70—Round trip—$40.85 (To Raleigh).

From Chattanooga—Leave via Pennsylvania Central Airlines' flight No. 141-132 at 8:30 A.M., arriving Greensboro at 2:58 P.M.

Return to Chattanooga—From Raleigh—Pennsylvania Central Airlines flight No. 131-142, departing 8:13 A.M., arriving Knoxville 9:56 A.M. Leave Knoxville 1:05 A.M., arriving Chattanooga 11:42 A.M.

One way fare—$19.00—Round trip—$34.19 (To Greensboro).

One way fare—$22.45—Round trip—$40.44 (To Raleigh).

From Knoxville—Leave via Pennsylvania Central Airlines' flight No. 141-132, 11:55 A.M. Arrive Raleigh at 3:33 P.M., *or* Leave on same flight—Arrive Greensboro 2:58 P.M.

Return to Knoxville—From Raleigh—Pennsylvania Central Airlines flight No. 131-142, departing 8:13 A.M., arriving Greensboro 8:47 A.M., leave Greensboro 9:02 A.M., arriving Knoxville 9:56 A.M.

One way fare—$17.60—Round trip—$31.68.

From Chicago—Leave via Eastern Airlines' flight No. 9 at $9:15 A.M., arrive Atlanta 3:25 P.M. Leave Atlanta via Eastern Airlines' flight No. 12 4:50 P.M. Arrive Greensboro 6:45 P.M., *or* Leave Chicago via Eastern Air Lines' flight No. 7 at 6:45 P.M., arrive Atlanta 1:05 A.M. Leave Atlanta via Eastern Air Lines flight No. 2 at 2:45 A.M. Arrive Greensboro 5:00 A.M.

Return to Chicago—From Raleigh—Pennsylvania Central Airlines flight No. 131-142, departing 8:13 A.M., arriving Knoxville 9:56 A.M., connecting with American Airlines trip No. 1 leaving Knoxville 10:50 A.M., arriving Nashville 11:53 A.M., connecting with Eastern Airlines trip No. 10, leaving Nashville at 1:05 P.M., arriving Chicago 4:20 P.M.

One way fare—$53.35—Round trip—$96.00 (To Greensboro).

One way fare—$57.45—Round trip—$105.35 (To Raleigh).

From Louisville—Leave via Eastern Air Lines' flight No. 9 11:20 A.M., arrive Atlanta 3:25 P.M. Leave Atlanta 4:50 P.M., flight No. 12 arrive Greensboro 6:45 PM. or Leave Louisville via Eastern Air Lines flight No. 7 at 9:05 P.M. Arrive Atlanta 1:05 A.M. Leave Atlanta 2:45 A.M., flight No. 2. Arrive Greensboro 5:00 A.M.

Return to Louisville—From Raleigh—Pennsylvania Central Airlines flight No. 131-142, departing 8:13 A.M., arriving Knoxville 9:56 A.M., connecting with American Airlines trip No. 1, leaving Knoxville 10:50 A.M., arriving Nashville 11:53 A.M., connecting with Eastern Airlines trip No. 10 leaving Nashville 1:05 P.M., arriving Louisville 2:15 P.M.

One way fare—$41.30—Round trip—$74.30 (To Greensboro).

One way fare—$45.40—Round trip—$81.65 (To Raleigh).

All meals served aloft are with the compliments of the Air Lines involved.

Raleigh, North Carolina, is the nearest airport from Pinehurst, a distance of approximately 80 miles. The Seaboard Airline Railway operates three trips daily, running time, two hours and fifteen minutes to Aberdeen, North Carolina, which is only six miles from Pinehurst.

Bus connections from Raleigh to Pinehurst—

Bus leaves Raleigh 8:00 A. M. arrives Pinehurst 11:00 A.M.
Bus leaves Raleigh 2:30 P.M., arrives Pinehurst 8:15 P.M.

Bus connections from Pinehurst to Raleigh—

Bus leaves Pinehurst 9:30 A.M., arrives Raleigh 12:40 P.M.
Bus leaves Pinehurst 10:25 A.M., arrives Raleigh 12:40 P.M.
Bus leaves Pinehurst 4:15 P.M., arrives Raleigh 11:00 P.M.

Fare—$1.90 one way.

RAIL

Railway Schedules Between Boston, Providence, New York, Philadelphia, Washington, Norfolk, Knoxville, Chicago, Chattanooga, and Louisville

Between Boston, Providence, New York, Philadelphia, Washington, Norfolk and Pinehurst

a1100p	1100a	Lv. Boston	NYNH&H	Ar.	855p	255p
1205a	1205p	Lv. Providence	NYNH&H	Ar.	755p	155p
1030a	630p	Lv. New York	PRR	Ar.	415p	855a
1217p	810p	Lv. Phila. (30th St.)	PRR	Ar.	231p	713a
300p	a1145p	Lv. Washington	RF&P	Ar.	1145a	b355a
355p		Lv. Norfolk	Ferry	Ar.	1030a	—
415p		Lv. Portsmouth	Seab	Ar.	1015a	—
1024p	755a	Ar. Southern Pines	Seab	Lv.	418a	711p
—	810a	Ar. Aberdeen	Seab	Lv.	—	700p
—	*815a	Lv. Aberdeen	N S	Ar.	—	*650p
—	*835a	Ar. Pinehurst	N S	Lv.	—	*630p

Between Knoxville and Pinehurst

550a	830a	Lv. Knoxville	Sou	Ar.	930p	555p
857p	250a	Ar. Raleigh	Sou	Lv.	835a	1155p
910p	630a	Lv. Raleigh	Seab	Ar.	535a	845p
1024p	755a	Ar. Southern Pines	Seab	Lv.	418a	711p
—	810a	Ar. Aberdeen	Seab	Lv.	—	700p
—	*815a	Lv. Aberdeen	N S	Ar.	—	*650p
—	*835a	Ar. Pinehurst	N S	Lv.	—	*630p

Between Chicago and Pinehurst

500p	1120p	Lv. Chicago (CT)	PRR	Ar.	610a	645a
145p	840p	Ar. Washington (ET)	PRR	Lv.	820a	150p
300p	a1145p	Lv. Washington	RF&P	Ar.	b355a	1145a
1024p	755a	Ar. Southern Pines	Seab	Lv.	711p	418a
—	810a	Ar. Aberdeen	Seab	Lv.	700p	—
—	*815a	Lv. Aberdeen	N S	Ar.	*650p	—
—	*835a	Ar. Pinehurst	N S	Lv.	*630p	—

Between Chattanooga, Atlanta and Pinehurst

455a	220p	Lv. Chattanooga (CT)	NC&StL	Ar.	1115a	1008p
820a	550p	Ar. Atlanta	NC&StL	Lv.	817a	645p
155p	730p	Lv. Atlanta (ET)	Seab	Ar.	720a	455p
1116p	418a	Ar. Southern Pines	Seab	Lv.	1024p	755a

Between Louisville and Pinehurst

555p	Lv. Louisville	C&O	Ar.	958a	
110p	Ar. Richmond	C&O	Lv.	530p	
548p	Lv. Richmond	Seab	Ar.	852a	
1024p	Ar. Southern Pines	Seab	Lv.	418a	

a—Sleping car open 10:00 P.M. b—Sleeping car parked for occupancy until 8:00 A.M. *—Through New York-Pinehurst sleeping car to be established about October 25th. Prior to that time Pinehurst passengers transfer by automobiles between Southern Pines and Pinehurst.

Railway Fares to Pinehurst, N. C.

	Round Trip Unrestricted 30 Day Limit	Pullman Lower One-Way	Pullman Upper One-Way
Boston, Mass (A)	$44.60	$6.60	$5.40
Providence, R. I. (A)	42.00	6.60	5.40
New York, N. Y.	29.00	4.50	3.40
Philadelphia, Pa.	23.85	3.95	3.00
Washington, D. C.	15.90	2.65	2.00
Norfolk, Va.	11.40	2.65	2.00
Atlanta, Ga.	16.15	2.90	2.20
Chattanooga, Tenn.	22.30	2.90	2.20
Knoxville, Tenn.	21.85	3.15	2.40
Chicago, Ill.	45.90	8.45	6.40
Louisville, Ky.	33.45	7.15	5.40

(A) Applies via Hell Gate Bridge.

We hope to be able to make arrangements with the Seaboard Airline Railway to have a sleeper set up Saturday night at Pinehurst so those wishing to return after the banquet Saturday night can retire in their sleeper which will be picked up on the train leaving Southern Pines at 4:18 A.M., Sunday morning. This extra service will be provided if there are enough members signifying their desire for such service in time to allow the committee to make arrangements with the Railway officials. Please advise Mr. Robert A. Bruce, Chairman of the Reception and Information Committee, P. O. Box 35, Greensboro, North Carolina, if you are interested in sleeping car accommodations leaving Pinehurst after the banquet Saturday night.

Many of the members may wish to stay over until Sunday and enjoy the unusual beauty and delightful climate of Pinehurst in the heart of the long-leaf pine section of North Carolina.

BUS

Bus Schedules and Fares Between Pinehurst, N. C., and Several Important Towns

Greyhound

Boston	Leave	8:00 A.M.	
Providence	Leave	10:15 A.M.	
New York	Arrive	5:20 P.M.	
	Leave	6:25 P.M.	
Philadelphia	Leave	1:30 P.M.	
Washington	Arrive	3:35 P.M.	
	Leave	4:00 A.M.	
Greensboro	Arrive	2:35 P.M.	
	Leave	5:30 P.M.	
Pinehurst	Arrive	8:15 P.M.	

Greyhound

Norfolk	Leave	7:00 A.M.	
Greensboro	Arrive	2:35 P.M.	
	Leave	5:30 P.M.	
Pinehurst	Arrive	8:15 P.M.	

Trailways

New York	Leave	7:30 A.M.	
Raleigh	Arrive	12:30 P.M.	
	Leave	2:30 P.M.	
Sanford	Leave	3:45 P.M.	
Pinehurst	Arrive	8:15 P.M.	

Greyhound

Atlanta	Leave	8:15 P.M.	Or	1:30 A.M.	
Charlotte	Arrive	4:10 A.M.	Or	9:50 A.M.	
	Leave	7:00 A.M.	Or	11:05 A.M.	
	Via Rockingham			Via Raeford	
Pinehurst	Arrive	10:25 A.M.		Ar. 4:15 P.M.	

Greyhound

Chattanooga	Leave	6:00 P.M.	Via Knoxville	Leave	10:30 P.M.	
Asheville	Arrive	2:15 A.M.	Via Knoxville	Arrive	6:30 A.M.	
	Leave	2:45 A.M.	Via Knoxville	Leave	7:15 A.M.	
Charlotte	Arrive	6:45 P.M.	Via Knoxville	Arrive	11:05 A.M.	
	Leave	7:00 A.M.	Via Knoxville	Leave	11:05 A.M.	
Rockingham	Arrive	9:15 A.M.	(Via Raeford)			
	Leave	9:40 A.M.				
Pinehurst	Arrive	10:25 A.M.		Arrive	4:15 P.M.	

Greyhound

Knoxville	Leave	8:45 P.M.	Or	Leave	2:00 A.M.
Asheville	Arrive	1:15 A.M.	Or	Arrive	6:30 A.M.
	Leave	2:45 A.M.	Or	Leave	7:15 A.M.
Charlotte	Leave	7:00 A.M.	Or	Leave	11:05 A.M.
Pinehurst	Arrive	10:25 A.M.	Or	Arrive	4:15 P.M.

Greyhound

Louisville	Leave	6:45 A.M.	Or	11:00 A.M.	
Lexington	Arrive	9:40 A.M.	Or	1:55 P.M.	
	Leave	10:00 A.M.	Or	2:30 P.M.	
Knoxville	Arrive	5:25 P.M.	Or	10:00 P.M.	
	Leave	8:45 P.M.	Or	2:00 A.M.	
Asheville	Arrive	1:15 A.M.	Or	6:30 A.M.	
	Leave	2:45 A.M.	Or	7:00 A.M.	
Charlotte	Arrive	6:45 A.M.	Or	11:05 A.M.	
	Leave	7:00 A.M.	Or	11:05 A.M.	
Pinehurst	Arrive	10:25 A.M.	Or	4:15 P.M.	
	(Via Rockingham)			(Via Raeford)	

Greyhound

Chicago	Leave	10:00 P.M.
Cincinnati	Arrive	7:15 A.M.
	Leave	7:45 A.M.
Knoxville	Arrive	5:25 P.M.
	Leave	8:45 P.M.
Asheville	Arrive	1:15 A.M.
	Leave	2:45 A.M.
Charlotte	Arrive	6:45 A.M.
	Leave	7:00 A.M.
Pinehurst	Arrive	10:25 A.M. (Via Rockingham)

Greyhound

Chicago	Leave	1:00 P.M.	
Cincinnati	Arrive	11:59 P.M.	
	Leave	12:15 A.M.	
Charleston	Arrive	7:00 A.M.	
	Leave	7:30 A.M.	
Winston-Salem	Arrive	5:00 P.M.	
	Leave	5:15 P.M.	
Pinehurst	Arrive	8:15 P.M.	(Via Biscoe)

Trailways

Boston	Leave	10:00 A.M.	
New York	Arrive	6:53 P.M.	
	Leave	7:35 P.M.	
Philadelphia	Leave	10:50 P.M.	
Washington	Arrive	3:35 A.M.	
	Leave	3:45 A.M.	
Raleigh	Arrive	12:30 P.M.	
	Leave	2:30 P.M.	
Sanford	Leave	3:45 P.M.	
Pinehurst	Arrive	4:30 P.M.	

Trailways

Providence	Leave	8:00 A.M.	
New York	Arrive	6:45 P.M.	
	Leave	7:30 P.M.	
Washington	Arrive	3:35 A.M.	
	Leave	3:45 P.M.	
Raleigh	Arrive	12:30 P.M.	
	Leave	2:30 P.M.	
Sanford	Leave	3:45 P.M.	
Pinehurst	Arrive	4:30 P.M.	

One Way Fares—Round Trip Fares Double One Way Less 10%

Boston	to	Pinehurst	$10.65	
Providence	to	Pinehurst	10.40	
New York City	to	Pinehurst	7.90	
Philadelphia	to	Pinehurst	6.70	
Washington	to	Pinehurst	4.95	
Norfolk	to	Pinehurst	4.60	
Atlanta	to	Pinehurst	5.20	(Via Rockingham $5.15)
Chattanooga	to	Pinehurst	5.70	(Via Rockingham $5.80)
Knoxville	to	Pinehurst	4.65	
Chicago	to	Pinehurst	11.75	
Louisville	to	Pinehurst	7.95	(Via Biscoe $7.50)

OCTOBER 31—NOVEMBER 1

THE CAROLINA

PINEHURST, N. C.

Twenty-first

ANNUAL MEETING AND CONVENTION

—RESERVATIONS—

If you have not made your reservations for rooms and sport activities at Pinehurst, **DO IT NOW** through—

D. Stewart Quern
Chairman, Reservation Committee
1930 Harris Road
Charlotte, N. C.

See issue of August 18th
AMERICAN DYESTUFF REPORTER
for hotel rates.

PINEHURST, N. C.
OCT. 31 — NOV. 1

CALENDAR OF COMING EVENTS

Meeting, New York Section, Chemists' Club, New York City, October 17th, 1941.

Annual Meeting and Convention, Pinehurst, N. C., October 31st-November 1st, 1941.

Comparison of Some Physical Properties Affecting the SERVICEABILITY of Certain Wool, Rayon, and Wool and Rayon Mixed Fabrics*

HAZEL FLETCHER, MARY CAROLINE BOYER and SISTER MARY CATHERINE FLOERSCH**

INTRODUCTION

RAYON staple fiber makes possible the production of fabrics similating wool. Some of these wool-like rayons are of all viscose, and others are mixtures of viscose and acetate rayon. Rayon staple fiber also may be mixed with wool to form rayon and wool mixtures. The desirability of the change from all wool to wool and rayon mixtures is largely due to the varied textures and effects made possible by mixing staple rayon fibers with wool.

The purpose of this study was to compare the serviceability of all rayon, all wool, and wool and rayon mixed fabrics.

MATERIALS

Materials used included 2 all wool fabrics, 8 spun rayon fabrics of wool-like texture, and 10 wool and rayon mixed fabrics. Table I gives data concerning the physical characteristics of these.

METHODS

Each of these fabrics was divided in 3 pieces. One was kept as a control; another was dry cleaned 5 times and the third 10 times. The dry cleaning was done by a commercial dry cleaning establishment. Breaking strength and elongation, abrasion, shrinkage, and crease-resistance determinations were made on the controls and after 5 and 10 dry cleanings to test the serviceability of the fabrics.

The breaking strength and elongation determinations were obtained by the ravel-strip method on a Scott strength tester at standard conditions according to the method outlined by Committee D-13[1]. Ten strips on the warp and filling were prepared for the dry breaking strength; likewise 10 each way were prepared for the wet breaking strength. Since the thread count of the samples for breaking strength varied as a result of shrinkage and abrasion, all the results of breaking strength for each material were corrected to the thread count of the dry control as follows: The breaking strength was multiplied by the thread count of the control and the product was divided by the thread count of the sample broken. The means of breaking strength and elongation are given in Tables II and III.

The relative wearing qualities of the fabrics were obtained by comparing the breaking strength of the original fabrics with pieces that had been abraded by a M.I.T. model abrasion tester. Strips 6 x 24 inches were abraded 500 times using a one-inch roller and crocus cloth for the abradant[2]. The means of the results are shown in Table II.

Shrinkage was determined by comparison of measurements made before and after dry cleaning. Squares 10 inches in dimension were marked off on the fabric with white cotton thread. These squares were measured after 1, 5, and 10 dry cleanings; and the percentage of shrinkage was calculated. The means of the results on shrinkage are given in Table IV.

To measure the crease resistance of each fabric the creasing-angle method developed by Schiefer[3] was followed. Ten specimens 2 x ½ inches were prepared both warpwise and fillingwise. These were tested after they had been conditioned for at least 4 hours in a standard atmosphere at 65 per cent humidity and 70° F. Table V shows the means of the results on resilience.

RESULTS

The data on breaking strength, elongation, shrinkage and resilience were evaluated by the analysis of variance† (4, 5). A probability of 5 per cent was regarded as significant, 1 per cent as highly significant and .1 per cent as very highly significant in the interpretation of differences.

Breaking Strength

The following shows the results of the analysis of data on breaking strength:

*Contribution No. 94, Department of Home Economics, Kansas Agricultural Experiment Station.

**Contributions by the junior writers were based on results reported in Master's theses; The Service Qualities of Certain Spun Rayon Fabrics of Wool-like Texture, Comparison of the Service Qualities of Certain All Wool, All Rayon, and Wool and Rayon Mixed Fabrics Before and After Dry Cleaning. On file, Library, Kansas State College of Agriculture and Applied Science.

†Appreciation is expressed to Dr. H. C. Fryer of the Department of Mathematics of Kansas State College for supervising the statistical analysis of the data.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Fabrics (wool, rayon, mixtures)	2	1,060.18	530.09***
Dry cleanings (0, 5, 10)	2	8.54	4.27
Treatments (dry, wet, abraded)	2	11,385.21	5,692.60***
Warp vs. filling	1	409.81	409.81**
Fabrics x dry cleanings	4	29.08	7.27
Fabrics x treatments	4	3,411.51	852.88***
Fabrics x warp vs. filling	2	117.49	58.74
Dry cleanings x treatments	4	551.60	137.90*
Dry cleanings x warp vs. filling.	2	1.90	0.95
Treatments x warp vs. filling.	2	232.00	116.00
Error	334	16,298.42	48.79

*Significant.
**Highly significant.
***Very highly significant.

In the above table the F-test of significance was used. The analysis showed that the successive dry cleanings had no effect on the breaking strength. There were very highly significant differences between the breaking strength of the different kinds of fabrics and highly significant differences between that of the warp and filling. The dry, wet and abraded breaking strengths differed by very highly significant amounts. Also the interaction of fabrics x treatments was very highly significant.

To test the differences between specific fabrics, treatments, etc., the t-test was used on the arithmetic means. The following shows the differences in the means of breaking strength for probabilities of .05, .01, and .001 used in the t-test:

Differences Between	Probabilities .05	.01	.001
Warp and filling	1.44	1.89	2.45
Rayon and wool	2.58	3.39	4.39
Rayon and mixtures	1.54	2.02	2.61
Mixtures and wool	2.52	3.32	4.29
Dry and wet	1.77	2.33	3.02
Dry and abraded	1.77	2.33	3.02
Wet and abraded	1.77	2.33	3.02
Rayon and wool in each treatment	4.45	5.85	7.57
Rayon and mixtures in each treatment	2.66	3.50	4.52
Mixtures and wool in each treatment	4.35	5.72	7.40

The warp breaking strength was greater than that of the filling by a highly significant difference. The means of these were 18.0 and 15.8 as shown in Table II. The difference between these means was 2.2, and the table on differences shows that this fell between the .01 and .001 probabilities. Since the difference, 2.2, would occur less than one time in 100 during random sampling from a homogeneous population, it was called a highly significant difference. Breaking strength of rayon and the mixed fabrics showed no significant difference. Both of these were greater than wool by a very highly significant amount.

The dry, wet and abraded breaking strength showed very highly significant differences. The dry breaking strength was the greatest, and the wet breaking strength was the least. There were significant differences between the dry, wet and abraded breaking strengths for the different kinds of fabrics. The dry breaking strengths of the rayon and mixed fabrics were greater than the wool by a very highly significant amount, and the dry strength of rayon was significantly greater than that of the mixtures. The wet breaking strength of rayon was greater than that of the mixed fabrics by a very highly significant amount and was just significantly greater than that of wool. There was not a significant difference between the abraded breaking strength of wool and rayon, but the abraded breaking strength of the mixed fabrics was greater than that of either the rayon or the wool by a very highly significant difference.

Elongation

The analysis of variance of the data for elongation showed that dry cleanings had no effect on the elongation, and that the elongation for the warp and filling had no significant difference. There were very highly significant differences for the elongation of different kinds of fabrics and for the dry, wet and abraded elongations. The fabrics x treaments interaction was very highly significant.

The dry, wet and abraded elongations showed very highly significant differences. The wet elongation was the greatest and the abraded the least.

The wool, rayon and mixed fabrics differed in elongation by very highly significant amounts; wool had the highest elongation and rayon the least. In case of the dry elongation there was not a significance between the rayon and mixtures; the dry elongation for wool was greater than that for rayon by a very highly significant difference and was highly significantly greater than the mixtures. The wet elongations for the three kinds of fabrics had very highly significant differences; wool had the greatest and rayon the least. In the case of the abraded elongation there was not a significant difference between the wool and the mixed fabrics; the elongations for the wool and the mixtures were greater than for rayon by a very highly significant amount.

Shrinkage

The analysis of data for shrinkage showed very highly significant differences of shrinkage for the number of dry cleanings, for the kinds of fabrics, and for the warp and filling. The fabrics x warp vs. filling interaction was very highly significant.

The wool and rayon fabrics showed no significant difference in shrinkage; the shrinkage of the mixed fabrics was greater than either wool or rayon by a very highly significant amount. The shrinkage increased with the number of dry cleanings; however, the shrinkage from 1 to 5 was greater than from 5 to 10 dry cleanings. There were differences of a very highly significant amount between 1 and 5 and also between 1 and 10 dry cleanings, and a highly significant difference between 5 and 10 dry cleanings. The warp shrinkage was greater than that of the filling by a very highly significant difference. In the filling the shrinkage of the mixed fabrics was greater than either wool or rayon by very highly significant differences. In the warp the shrinkage of the mixed fabrics was greater than the rayon by a highly significant amount and was significantly greater than the wool.

TABLE I
Data of Physical Characteristics of the Fabrics Tested

Fabrics	Width (In.)	Wt. Per Sq. Yd. (Oz. Dry Wt.)	Thread Count		Weave	Twist Per In.		Crimp %		Yarn Counts (Worsted, Dry Wt.)		% Singeing	% Fiber Content	
			Warp	Filling		Warp	Filling	Warp	Filling	Warp	Filling		Wool	Rayon
							Wool							
1	40	3.9	50.0	40.0	1/1	14.5 ± 1.4	12.6 ± 0.3	5.3	5.3	25.8	28.9	0.1	100.0	
2	56	3.5	52.3	44.6	1/1	14.0 ± 1.9	13.1 ± 1.5	8.0	14.2	28.6	34.2	2.3	100.0	
							Rayon							
3	39	3.6	43.0	43.0	1/1	15.3 ± 2.3	13.7 ± 1.4	2.5	1.2	11.2	19.2	0.0	Viscose rayon	Acetate rayon 100.0
4	40	4.1	57.8	48.1	1/1	31.3 ± 2.3	34.8 ± 2.1	7.9	14.2	18.8	21.3	2.1	74.9	25.1
5	40	4.6	35.8	31.3	1/1	10.7 ± 3.9	11.7 ± 1.2	8.9	8.6	10.4	10.2	.6		100.0
6	40	5.9	100.1	48.0	1/1	2.7 ± 0.7	83.8 ± 4.2	8.4	17.8	23.9	13.4	.3		100.0
7	38¾	4.8	73.0	56.2	2 twill / 2	17.9 ± 3.3	13.6 ± 2.7	4.3	8.2	21.9	17.9	1.1	51.8	48.2
8	39	3.8	60.8	51.9	1/1	18.7 ± 3.0	20.0 ± 2.2	9.1	12.6	23.5	21.8	1.9	67.0	33.0
9	38¾	4.7	35.3	30.1	1/1	12.9 ± 3.0	9.2 ± 2.8	12.8	12.9	10.8	10.6	1.5	80.6	19.4
10	39	4.2	60.2	53.6	1/1	18.8 ± 2.1	26.0 ± 3.4	10.8	14.2	22.2	20.0	1.7	61.4 Wool	38.6 Viscose rayon
							Wool and Rayon Mixtures							
11	54	3.8	36.7	35.9	1/1	12.3 ± 1.7	8.8 ± 0.2	3.9	5.0	18.8	20.4	.2	94.6	5.4
12	52	5.2	58.0	42.0	2 basket / 2	33.2 ± 5.2	33.1 ± 4.8	13.9	10.8	25.7	19.5	.2	92.0	8.0
13	54	4.0	38.9	36.0	1/1	17.7 ± 0.8	15.9 ± 1.1	4.5	5.6	20.9	22.3	.1	71.3	28.7
14	54	5.2	35.0	30.0	1/1	12.5 ± 0.8	12.2 ± 0.1	6.0	6.9	11.2	19.2	.3	63.0	37.0
15	54	5.1	33.0	29.3	1/1	4.9 ± 0.3	4.8 ± 0.4	7.2	5.1	13.3	13.1	.4	51.9	48.1
16	52	3.9	49.0	49.0	novelty twill	11.8 ± 1.0	8.4 ± 1.7	5.1	5.1	30.9	28.3	.1	51.3	48.7
17	54	3.8	55.8	51.0	1/1	23.5 ± 0.6	21.3 ± 1.4	12.3	11.4	32.9	30.0	.1	34.9	65.1
18	52	5.5	42.0	38.0	mock leno	6.7 ± 0.2	6.8 ± 0.4	3.2	5.2	18.3	15.0	.2	13.6	86.4
19	56	4.5	47.4	43.8	1/1	14.2 ± 1.4	16.4 ± 0.8	12.5	14.2	24.4	21.8	3.0	15.6	83.4
20	56½	4.4	67.0	65.4	novelty twill	19.2 ± 0.8	18.9 ± 0.9	13.5	6.0	33.5	33.4	1.9	16.6	83.4

TABLE II

Means of Breaking Strength in Pounds for Wool, Rayon, and Wool and Rayon Mixed Fabrics Before and After Dry Cleaning

No. of Dry Cleanings	Wool						Rayon						Wool and Rayon Mixtures						Means
	Dry		Wet		Abraded		Dry		Wet		Abraded		Dry		Wet		Abraded		
	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling	
0	19.1	10.0	12.7	7.9	13.0	7.6	29.6	24.5	15.8	14.7	8.4	11.1	24.0	21.5	14.4	12.2	17.8	17.0	17.0
5	20.2	11.4	10.1	5.7	11.1	8.5	29.6	25.4	15.5	13.7	8.9	11.0	27.0	24.6	8.2	7.2	21.6	18.9	17.0
10	21.4	11.5	9.4	8.6	13.8	10.0	30.5	24.7	14.7	12.8	9.9	11.2	26.0	22.5	7.7	7.0	20.4	18.5	16.7
Means	20.2	10.9	10.7	7.4	12.6	8.7	29.9	24.9	15.4	13.7	9.1	11.1	25.6	22.9	10.1	8.8	19.9	18.1	
	15.6		9.0		10.7		27.4		14.6		10.1		24.2		9.4		19.0		
	11.8						17.3						17.6						

Means	Dry	24.6
	Wet	11.4
	Abraded	14.6
	Warp	18.0
	Filling	15.8

TABLE III

Means of Elongation in Per Cent for Wool, Rayon, and Wool and Rayon Mixed Fabrics Before and After Dry Cleaning

No. of Dry Cleanings	Wool						Rayon						Wool and Rayon Mixtures						Means
	Dry		Wet		Abraded		Dry		Wet		Abraded		Dry		Wet		Abraded		
	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling	
0	25.0	20.5	43.4	39.5	17.4	16.2	16.9	16.9	19.6	19.8	8.1	8.8	17.6	17.9	35.4	31.1	14.4	15.0	19.7
5	31.2	23.3	40.8	36.5	18.2	18.2	16.9	17.0	19.5	20.0	10.3	10.6	20.4	19.9	26.0	23.6	18.4	17.3	19.6
10	31.5	24.0	42.3	46.3	24.3	21.7	17.6	16.6	20.1	18.5	9.1	9.7	19.2	18.0	26.5	24.4	17.4	17.1	19.4
Means	29.2	22.6	42.2	40.8	19.9	18.7	17.3	16.8	19.7	19.3	9.2	9.7	19.1	18.6	29.3	26.4	16.7	16.4	
	25.9		41.5		19.3		17.1		19.5		9.5		18.8		27.8		16.6		
	28.9						15.3						21.1						

Means	Dry	18.8
	Wet	25.9
	Abraded	14.0
	Warp	20.0
	Filling	19.1

TABLE IV

Means of Shrinkage in Per Cent for Wool, Rayon, and Wool and Rayon Mixed Fabrics Before and After Dry Cleaning

No. of Dry Cleanings	Wool		Rayon		Wool and Rayon Mixtures		Means
	Warp	Filling	Warp	Filling	Warp	Filling	
1	1.3	1.0	1.7	.8	2.3	1.3	1.5
5	2.7	1.6	3.7	2.3	4.1	3.9	3.4
10	4.0	2.1	3.8	2.3	5.0	4.8	4.0
Means	2.7	1.6	3.1	1.7	3.8	3.3	
	2.1		2.4		3.6		

Means	Warp	3.4
	Filling	2.5

TABLE V

Means of Resilience Ration in Per Cent for Wool, Rayon, and Wool and Rayon Mixed Fabrics Before and After Dry Cleaning

No. of Dry Cleanings	Wool		Rayon		Wool and Rayon Mixtures		Means
	Warp	Filling	Warp	Filling	Warp	Filling	
0	88.3	86.2	69.9	72.7	85.0	83.1	79.3
5	85.9	84.8	71.8	71.9	83.7	81.4	78.5
10	84.5	83.9	71.4	72.3	83.0	81.6	78.3
Means	86.2	85.0	71.1	72.3	83.9	82.0	
	85.6		71.7		83.0		

Means	Warp	79.0
	Filling	78.4

Resilience

The analysis of the data for resilience showed very highly significant differences for the kinds of fabrics. There was not a significant difference of resilience in warp or filling, after dry cleanings or in the interactions. The wool and mixed fabrics had no significant difference of resilience, and both of these were greater than the rayon by very highly significant amounts.

CONCLUSION

The statistical analysis of the data showed significant differences in the characteristics of these three kinds of fabrics. The rayon and mixed fabrics had much higher breaking strength than the wool, and the mixtures were more resistant to abrasion than either wool or rayon. Dry cleaning did not affect the breaking strength. The three kinds of fabrics had very highly significant differences in elongation. The wool had the greatest and rayon the least. The difference in shrinkage of wool and rayon was not significant. The mixed fabrics shrank much more than either the wool or rayon. The wool and mixed fabrics were similar in resistance to creasing, and both were much more crease resistant than the rayon.

LITERATURE CITED

[1]Committee D-13 on Textile Materials. Philadelphia. A.S.T.M. Standards on Textile Materials. 368 p. 1940.

[2]Skinkle, John H. Textile Testing. New York. Howes Publishing Co. 267 p. 1940.

[3]Schiefer, Herbert F. Evaluation of Crease-resistance Finishes for Fabrics. Nat'l Bur. Standards, Jour. Res. 20:241-252. 1938.

[4]Snedecor, George W. Statistical Methods Applied to Experiments in Agriculture and Biology. Ames, Iowa. The Iowa State College Press. 422 p. 1940.

[5]Fisher, R. A. and Yates, F. Statistical Tables for Biological, Agricultural, and Medical Research. London. Oliver and Boyd. 90 p. 1938.

Full-Fashioned Cotton Hose—

(Continued from page 478)

number of hose of construction D were discarded early in the study because of accidents.

Based on the 120/2 stretch welt construction with 58 pairs and a standard deviation of 7.07 for time of discarding, it was calculated that 61 pairs of hose are required to obtain an average, correct to plus or minus 1 day, 9 times out of 10 trials. Although this is a low probability it is usually considered sufficiently high accuracy in a consumer wear test. To increase the accuracy would require such a large sample that the time and cost of the study would be excessive.

It is estimated that ten dozen pairs of each construction are required for future wear tests conducted under conditions similar to the ones existing for this study.

Statistical analyses show that the four hose for laboratory tests in any construction at any one period should be increased to at least six. For a wear study on hosiery, provision for more than the minimum number of 61 pairs, for determining length of service, and the hose needed for testing should be made in order to offset accidents and losses which are inevitable in a consumer wear test.

SUMMARY AND CONCLUSIONS

Four constructions of cotton hose, 90/2 plain welt, 90/2 stretch welt, 120/2 plain welt, and 120/2 stretch welt, knit from commercial yarns, were worn in rotation by 68 student nurses. They were worn one day, laundered the next, and the following day returned to the nurses.

The students were divided into four groups of 17 each on the basis of their weight and height. At regular intervals of wear and laundering, hose of all four constructions were taken for laboratory analysis from four girls, one in each of the four groups. This method of sampling by groups based on height and weight increased the work. Since group was not a significant source of variation, the choice of test hose was unnecessarily restricted.

As service progressed, bursting strength decreased, and fluidity in cuprammonium hydroxide increased showing increased deterioration. The values for elastic properties fluctuated, due no doubt to the fact that only four hose were used at any one test period. The cotton cellulose was not in a highly deteriorated condition at the final test period, for the maximum fluidity value found for a leg sample after completion of the service periods was 7.96 reciprocal poises and for a foot sample 6.80. For all constructions except the 90/2 stretch welt hose, the cotton of the leg portion became more deteriorated than the cotton of the foot as indicated by the higher fluidity values of the leg samples.

Hose made of 90/2 yarn were stronger in bursting strength after 32 days of wear than were the 120/2 hose when new. The elongation values automatically recorded at the time of bursting were higher for the 90/2 hose than for the 120/2. A greater load was required to stretch the lighter weight hose from 19.2 inches in circumference to 20.2 inches (s'-s) than was required for the heavier hose with the same type of welt. These latter two test results indicate that the 120/2 hose were tighter on the leg, probably due to the greater number of courses in this weight of hose.

Type of welt was a significant source of variation for the elastic properties of the hose. At any test period the load required to stretch the hose from 19.2 to 20.2 inches circumference was higher for the plain than the stretch welt. The lower values mean a stretch welt hose is less binding on the leg and probably explains the students' preference for them. Of the two constructions knit from 120/2 yarn, the plain welt hose had higher recovery-stretch ratios. These higher values of the plain welt 120/2 hose by both tests for elastic properties indicate that this construction was tighter on the leg than the stretch welt hose

knit from the same yarn. This difference was not so pronounced for the 90/2 constructions.

The 120/2 stretch welt hose had an average length of service of 22.4 days, the plain welt 23.2 days; whereas the 90/2 stretch lasted 33.7 days and the plain 31.0. The length of service of different numbers of hose was averaged so the standard deviation ranged from 7.07 to 10.55. Since the number of hose discarded was limited, the small variations in average length of service between hose of the same yarn are not conclusive evidence of the superiority of either type of welt, but the larger difference between the 90/2 and 120/2 weights shows that the 90/2 hose are more durable.

For these hose there was a high correlation between the wales or gauge and bursting strength when the hose were new but not after the hose were worn. Courses were not correlated with the strength of either the new or worn hose.

The techniques of conducting wear tests can be improved by using not less than 10 dozen pairs in each construction studied, by increasing the number of test hose at any test period to six, and by sampling at random without regard to height and weight. The test interval might well be extended from four to six washes. It is recommended that the test for stretch endurability be continued for each hose until failure occurs. This is necessary in order to secure suitable data for determining the relative merits of the different constructions as evaluated by this test.

In addition to stretch endurability, recovery-stretch ratio (r/s) and increase in stretch load (s'-s) as measured by the Frazier test, bursting strength, and fluidity are valuable means of determining deterioration resulting from service.

Areas of wear and days of service are useful as guides for indicating desirable construction changes. This study shows that in the case of duty hose, larger and stronger foot reinforcements, particularly in the toe sections are needed.

The results of the following tests did not correlate with the length of service of the four constructions of cotton hose: wale count, course count, shrinkage, weight, weight distribution, and elongation. These tests are not being used for the wear studies now in progress at the Bureau of Home Economics.

Since consumer wear tests are time consuming, it would be helpful to be able to predict durability by laboratory tests. The work reported here indicates that the Frazier test for elastic properties, bursting strength, and fluidity are valuable for this purpose, but at present the data are insufficient to determine any correlations of this nature. It may also prove feasible to develop techniques so that the durability to be expected from various types of reinforcements could be predicted by laboratory abrasion data.

LITERATURE CITED

[1]Anonymous. 1940. Technical advances in hosiery field and consumer standards feautre research group report. Underwear and Hosiery Rev. 23 (5): 105-106.

[2]Anonymous. 1940. Nylon: results of wear tests. Consumers Union Reports 5 (7): 3-4, illus. (Tech. sec. 3-4).

[3]American Society for Testing Materials. 1940. A.S.T.M. standards on textile materials. 368 pp., illus. Philadelphia.

[4]Anders, I. A. 1938. A study of the practice of a selected group of employed women in the buying and care of hosiery. Jour. Home Econ. 30: 554-555.

[5]Foster, B. H. 1933. Bursting and grab tests for knit fabrics compared. Textile Research 3: 281-286, illus.

[6]Gragg, M. T., and Borden, N. H. 1938. Merchandise testing as a guide to consumer buying. Harvard Univ. Grad. School of Business Admin., Vol. 25, No. 6, Business Res. Studies 22, 84 pp. Boston, Mass.

[7]Hays, M. B., Petersen, E. C., and Taylor, D. A. 1940. Physical properties of women's full-fashioned hosiery knit from commercial cotton yarns. Jour. Home Econ. 32: 467-474, illus.

[8]Herschel, W. H., and Bulkley, R. 1927. Calibrations of the buret consistometer. Indus. and Engin. Chem. 19: 134-139, illus.

[9]Richardson, J. E., and Baker, V. 1938. Selection, care, and wearing qualities of women's silk hosiery. Mont. Agr. Expt. Sta. Bull. 299, rev., 58 pp., illus.

[10]Schenke, E. M., and Shearer, H. E. 1938. Methods of testing hosiery. U. S. Dept. Com. Natl. Bur. Standards Cir. C422, 34 pp., illus.

[11]Schiefer, H. F., and Cleveland, R. S. 1935. Factors affecting the performance of hosiery on the hosiery-testing machine. U. S. Natl. Bur. Standards Jour. Res. 14: 1-16, illus.

[12]United States Bureau of Agricultural Economics and Home Economics. A study of the Raw Cotton and the Yarn and Sheeting Manufactured from Three Grades of American Upland Cotton. U. S. Dept. Agr. Tech. Bull. 406, 70 pp., illus.

TRADE NOTES • NEW PRODUCTS

• FABRIC PERMEATER

The Cambridge Instrument Co., Inc., Grand Central Terminal, New York City, announces the manufacture of a new instrument called the Fabric Permeater which is claimed to provide an accurate, rapid and convenient means for production testing of the permeability of fabrics which are to be inflated with hydrogen, helium, carbon dioxide, etc. The rate of permeation through the fabric is determined by equipment utilizing the thermal conductivity method of gas analysis and is indicated in terms of "liters per square meter per 24 hours" of the retained gas. The instrument determines the rate of diffusion of gases through balloon fabrics and other materials and enables a testing of the effectiveness of various dopes with which the fabrics are treated. Lateral diffusion as well as leakage at seams can be determined. Full details are available upon request to the manufacturers.

• CHANGES IN STAFF

The following changes in the textile engineering staff at Texas Technological College, Lubbock, Texas, have been announced:

Worth Ganel will teach yarn manufacture, testing and cotton classing and will have the rank of assistant professor. He was formerly research engineer for U. S. Rubber Co. at Hogansville, Ga.

Lloyd Jackson will teach textile chemistry and dyeing. He was formerly with Ciba Co., Inc., in New York.

• URGE INFORMATIVE LABELS

Southern garment manufacturers were outspoken in their support of informative labeling at the Atlanta convention held recently, it was reported recently by William Stutts, representative of American Viscose Corporation. Asserting that he had discussed the idea of labeling with many of the leading Southern manufacturers, Mr. Stutts stated that this trade is apparently thoroughly convinced of the value of providing factual labels for the

benefit of retailers and consumers alike. Keeping returned goods to a minimum, and stimulating sales, were given as the two main reasons for their support of informative labels, he said. In this respect, he added, the identification of Crown Tested rayon fabrics was frequently cited by these manufacturers as an example of a labeling program that helps sell merchandise and helps keep it sold.

• EXECUTIVE CHANGES AT WESTVACO

Louis Neuberg, Vice-President in Charge of Sales of Westvaco Chlorine Products Corporation, has announced the promotions of W. N. Williams and J. Rivers Adams, effective August 1, 1941. Mr. Williams is advanced from Manager of Sales to Assistant to the President, while Mr. Adams succeeds to the position of Manager of Sales.

W. N. Williams

J. Rivers Adams

Mr. Williams became associated with Westvaco Chlorine Products Corporation in 1924. In 1929, he was placed in charge of two West Coast subsidiaries, Barium Products, Ltd., of Modesto, California, and Peroxide Manufacturing and Specialty Company of San Francisco. In 1933, Mr. Williams was transferred to California Chemical Company, where he became Assistant to the President, which position he held until being made General Manager of Western operations for Westvaco in 1937. Transferred to the New York office in 1938, as Manager of Sales, he became a member of the Board of Directors in July, 1941. Mr. Williams is also an officer and director of the Magnesol Company, subsidiary of Westvaco Chlorine Products Corporation.

A native of Lynchburg, Virginia, Mr. Adams graduated from V.M.I. in 1931 and joined Westvaco Chlorine Products Corporation in June of that year. He then spent a short time with Barium Products, Ltd., Modesto, California, until August, 1932, when he became Plant Superintendent, Assistant Works Manager, and later Works Manager at the Carteret, N. J., plant of Warner Chemical Company. In 1937, he joined the Sales Department at the New York office of Westvaco Chlorine Products Corporation.

Textile Industries Share In Civilian Defense Plans

Mobilization of Resources Calls For Coordination of Fire Fighters

LEONARD F. MAAR
Safety Research Institute

"An important factor in defense planning is the ability to utilize the great amount of private and industrial fire protection facilities to greater advantage."—W. Hendrix Palmer, president, International Association of Fire Chiefs.

THE beginning of civilian defense for all industry is the rapid mobilization of its private fire fighting resources. This has been recognized by the Office for Emergency Management in Washington, and, even before the Office for Civilian Defense was organized within the OEM, the task of coordinating public and private fire departments was begun.

For textile industries, this will require greater or lesser readjustment, according to the extent of existing fire protection facilities. Where the fire problem has been recognized and adequate provisions made to cope with it, the readjustments will be negligible. But where ordinary emergency services have been neglected, it may be necessary to reorganize the entire protective system.

British civilian defense authorities, tempered in the fires that have rained down out of the sky upon their country, say:

"Emergency measures for reducing the fire risk are mainly a matter of intensifying the precautions which ought to be in force at all times."

The diversity of fire hazards present in the many branches of textile manufacture, processing and finishing, permits of only a generalized discussion of fire defense here. But the means of "intensifying" fire precautions can be outlined, and this, perhaps, is what executives of the individual plants are most interested in at this time.

Fire defense is essentially a local problem, so its organization depends upon the local fire chief or other official having charge of this division of work. The first thing plant management can do for him is to supply him with a survey of the fire protective facilities of the plant.

This study will show the need for the expansion or reorganization of the plant fire brigade and its equipment; it will give the local Defense Fire Chief data upon which to develop a plan of cooperation between the plant brigade and the public fire department in emergencies. The information will go in permanent files and it should be kept up to date for defense purposes.

Briefly, the survey calls for mapping structural details, exposures to outside risks, the location of special hazards involved in processes or materials, the location of water mains, hydrants, shut-offs and standpipes, the location of elevated water storage tanks, details of the sprinkler system and of automatic extinguishing devices. Storage tanks of petroleum supplies or other inflammables, dye houses, the power house, transformer stations, cable lines,

switchboards, and all other vulnerable situations will be reduced to maps or blueprints. Inventories will be taken of fire extinguishers, wheeled extinguishers, fire hose, tools, etc. The personnel of the plant brigade will be listed along with a description of its organization and functions. Normal and auxiliary water supplies and the normal and emergency operation of the fire alarm communications system will be considered.

In putting the plant brigade upon an emergency footing, the general aim will be to make it self-reliant so it can put out fires without calling upon the public department. Sabotage or incendiary bombing may cause a number of fires to break out at the same time in different locations and the men on the spot must be capable of acting promptly and effectively.

For this reason, considerable attention is being given to the development of department fire brigades rather than a central brigade which may be required to cover the whole plant. The departmental system already is in force in many industries.

In each department, brigades are formed for each shift. The foreman acts as captain and, in most cases, is responsible for the training of the men under him. He, in turn, is responsible to the plant fire chief.

When a fire emergency occurs, the department brigade functions in this fashion. The foreman turns in an alarm on the proprietary system, calling the fire chief to the scene and notifying the other brigades in the plant to be on the alert. The same signal also notifies the engineer to start the fire pump and have it ready to go to work.

In the department, all men are trained to use fire extinguishers, but a special group is assigned to them in the functions of the brigade. These men know where the extinguishers are located, they know which types to use on the different classes of fire, and they know how to use them most effectively. In the majority of instances, the fire extinguisher detail will stop fire at its source with a minimum of damage and disturbance.

Another group of men in the brigade is assigned to lay hose from standpipe or hydrant. Still others take steps to move stock that may be in the path of danger or to protect machinery by covering it with tarpaulins.

Teams of two men each are assigned to shut off power, to close fire doors and open windows to ventilate the fire area, to stand by sprinkler valves, or perform other special duties.

By the time the fire chief arrives on the scene he probably will find the fire out, as the result of this rapid attack on the blaze. If additional men are needed, however, he can summon them over the proprietary alarm system or call in the public fire department.

This same departmental system is the foundation of fire defense in the event of war. Supplemented by first aid squads, rescue crews, and the other emergency services required by all-out defense, the departmental brigade can be trained quickly to handle the fires caused by incendiary bombs or high explosives.

All-out defense also will require that some protective construction be utilized. The OEM has devoted a bulletin to this subject, providing diagrams and plans for building shelters and protective barriers. There is no protection against the direct hit of a high explosive bomb, but protection can be afforded from the blast and splinters within a 25-foot radius of the point where a bomb strikes.

The dispatch with which these various stages of defense are adopted depends entirely upon the development of the international situation. But the planning stage is definitely at hand, when all eventualities must be considered and preparations laid down for them.

• CLASSIFIED • ADVERTISEMENTS

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED: Textile School graduate, draft exempt, with 2½ years' experience in Chemistry, Dyeing, Finishing and Cost Work, desires position as Dyer or Textile Chemist, preferably in South but will consider other offers. Excellent references. Write Box No. 341, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

A New Jersey chemical manufacturing corporation offers an opportunity to an experienced chemist, also of advanced age and preferably with experience in the textile chemical field for the development and manufacture of chemical specialties used in the textile and other industries. The position is permanent, and with increasing remuneration according to achievements. A person with a highly developed sense of responsibility capable to take charge of laboratory as well as production is required. Write Box No. 342, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: Education: Textile School Graduate. Alexander Hamilton Institute Business Course. Experience: Mature executive type of textile chemist and colorist. Over twenty years' broad general experience in factory, laboratory, purchasing and all-around business procedure. Good correspondent. Excellent personality. Wholesome appearance. Fine speaker. Literary and artistic ability. Real color sense. Possessing fund of factual information about material things in a wide range of industries. Capable of meeting the highest type of clientele and planning and directing the efforts of all types of personnel. Desires supervisory, contact, promotional or sales work. Willing to first prove ability and versatility. Age 44. American born, New England Yankee ancestry. Married. Write Box No. 343, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.